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Concrete-Cement Age

Devoted to the manufacture
and uses of Portland cement

New York DETROIT Chicago

10861

Published Monthly by the

Concrete-Cement Age Publishing Co.

97 Fort Street West
Phone: Main 571.
DETROIT

WALTER C. BOYNTON,
General Manager

R. MARSHALL,
Business Manager

Branch Offices:

NEW YORK: 30 Church Street. F. F. LINCOLN, Eastern Manager. Phone: Cortlandt 6452.

CHICAGO: 1020 1st Natl. Bank Bldg. R. M. BABBITT, Western Manager. Phone: Central 6502.

CLEVELAND: 635 Williamson Bldg., R. N. JACKSON, Manager.

SPOKANE, Wn.: 1108 Spofford Ave., FRED NIEDERHAUSER, Manager.

Subscriptions: $1.50 a year; single copies 15 cents. Canadian subscription, $2.00 a year. Foreign subscription $2.50 a year. In requesting change of address give former address also.

Advertising: Rates upon application. Complete information regarding size, character and distribution of circulation cheerfully furnished upon request.

Correspondence on all matters relating to the industry which the magazine represents is solicited by the EDITORS. Discussions, notes and inquiries will be gladly received.

Readers are especially invited to report their own work—to explain the problems which they solve—so that their magazine may really be an institution for the exchange of ideas of value in the industry.

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CONCRETE-CEMENT AGE PUBLISHING CO.
Entered as Second Class matter at the Detroit Post Office

ROBERT W. LESLEY, Consulting Editor ALLEN BRETT, Managing Editor
HARVEY WHIPPLE, Associate Editor

Index, Volume II, Jan.-June, 1913

12993/24/1/13

For the greater convenience of the reader this index has been made both titular and topical in nature. Original titles of articles have been amplified or condensed for the purposes of the index as seemed best. Nothing has been indexed under "concrete" and nothing under "cement." "Products" is a word used frequently because it covers the whole field of factory-made articles of concrete. Illustrated articles are denoted by an asterisk after the title. Editorials are designated by "E"; articles in the Information and Consultation department by "I-C"; Correspondence department matter by "C" and New Equipment Methods and Materials department articles by "Eq." The months and pages are given.

A

Acid Tanks, * ....May 225
Aggregates, Grading, *C* ....May 246
—Grading, *I-C* ....Jan. 21
—(N. A. C. U. Convention) ....Jan. 44
—The Use of Slag as Concrete, *E* ....Mar. 106
—Washing Concrete, *I-C* ....Feb. 76
Aiken System House in Chicago, * ....Mar. 110
Albany, Poured Concrete House at, * ....Mar. 110
Alkali Soils, Concrete in, *I-C* ....June 291
Allentown, Pa., Concrete Bridge, * ....April 161
American Highway Association Takes Stand for Federal Aid ....Feb. 88
—Society for Testing Materials, Annual Meeting of ....June 307
Ammonia, Action of, on Concrete, *I-C* ....Feb. 74
Analysis of Cement, Microscopic (N. A. C. U. Convention) ....Jan. 44
Ancients, Concrete Among the, *E* ....Jan. 2
Aqueducts, Uses of Steel Forms on, * ....Jan. 11
Architecture, Concrete, *E* ....June 259
Architectural Concrete (N. A. C. U. Convention) ....Jan. 44
—Stone Tooled by Machinery, * ....Feb. 61
Armored Tubular Floors, Design of ....May 228
Artificial Marble, *C* ....April 184
Asheville, N. C., Inn, General Features of, * ....May 229
Australia, Concrete Construction in, *C* ....Mar. 129
—Reinforced Concrete Buildings in, *C* ....May 246

B

Baltimore, Enclosing Jones Falls in Concrete, * ....Mar. 117
Baptismal Font at San Gabriel Mission, * ....June 299
Bar-Bender, A New, * *Eq* ....May 254
Barge, A Reinforced Concrete, in Service, * ....Feb. 93
Bar-Twisting Machine, A Motor Driven, * *Eq* ....June 302
Beam, A Test, Equipment, * ....Feb. 81
Beams, Pre-Cast, and Concrete Tile in Floor Construction, * ....Mar. 153
Belgium, Ornamental Concrete in, * ....Feb. 101
Belting, Uses of Steel Power, Increases Abroad ....May 225
Bench, Garden, * ....Jan. 17
Bending Machine, A Power, * *Eq* ....April 204
Blast Furnace, Cement Mortar in Hearth and Boshes of ....May 220
Block, An Architect's View of Concrete, * ....Feb. 66
—and Stucco House Costing $4,200, Details of Concrete, * ....April 191
—Attractive as to Color and Texture, House of Concrete, * ....June 297
—Concrete, Farm Buildings Built Economically in England, * ....Mar. 142
—Concrete, Houses Built for $1,500 Each, * ....Mar. 138
—Concrete, Houses in Italy, * ....Mar. 111
—Concrete, The Development of (a Symposium) ....Mar. 139
—Concrete, Walls of School Resist Fire Attack, * ....Jan. 46
—Criticism of Concrete, *C* ....Feb. 77
—Design, Concrete, *C* ....May 245
—Equipment to Make Reinforced Concrete, * *Eq* ....Mar. 158
—Face Up, Spraying Concrete, *C* ....April 183
—House at Leesburg, Ind., Concrete, * ....April 170
—House Built of White Face, * ....June 298
—Houses in England, * ....Feb. 73
—Machine, Wet Process, * *Eq* ....Jan. 53
—More Letters Wanted on the Concrete, *E* ....Mar. 106
—School, Concrete, * *C* ....May 247
—Special Concrete, for Corncribs, * June 264
—Spraying Freshly Made, *C* ....Jan. 25
—The Concrete, *E* ....Feb. 55
—The Development of Concrete, * *C* ....May 244
—The Development of Concrete, *C* ....May 246
—The Development of Concrete, *C* ....June 295
—Tooled by Machinery, * ....Feb. 61
—Walls in House, Concrete, * ....April 186
Boat, Concrete, * ....Feb. 93
Boiler Tube Floors ....June 299
—Pit, Waterproofing a, *I-C* ....Jan. 24
—Pit, Waterproofing a, *I-C* ....Mar. 123
Bonding Old and New Concrete, * *I-C* ....May 240
—Values of Waterproofing Compounds, *Eq* ....Mar. 154
Brazil, American Mixers in, *Eq* ....May 256
Brick, Concrete, Veneer and Stucco House, * ....Mar. 121
—A, Paper Reaches the Height of Absurdity, *E* ....June 260
—Machine, Tamper for, * *Eq* ....Mar. 157
Bridge at Zanesville Withstands the Flood, The "Y," *C* ....June 292
—Balustrade, Factory Made, * ....Feb. 63
—Concrete (N. A. C. U. Convention) ....Jan. 3
—Concrete, in Pittsburg (N. A. C. U. Convention) ....Jan. 5
—Concrete, to Withstand Flood, and Their Comparative Cost, *I-C* ....May 240
—Construction, Carrying Equipment on, * *Eq* ....Jan. 53
—Flood Area of Concrete, *I-C* ....June 289
—Materials, Unit Cost Data on, *Eq* ....Feb. 103
—A New, and Culvert Form, * *Eq* ....Mar. 157
—Reinforced Concrete, at Montclair, N. J., * ....Feb. 63
—Work, Cost of Surface Finish in, *C* ....Feb. 78
British Columbia, Construction Work in ....June 292
Buenos Aires, Use of Concrete in, *E* ....Mar. 113
Building at Memphis, Tenn., New Loft, * ....April 177

TA
680
C72
v.2

—at Niagara Falls, N. Y., An Illustration of Rapid, *...............April 175
Bulk Cement and the Mixer, *C*......Mar. 127
—Cement, The Economy of, *C*.....May 243
—Shipments of Cement, * *C*.......Jan. 27
—Shipment of Cement in, *E*......April 160
Buoys in Jamaica, Floating Concrete, *.. ....April 186
Bureau of Standards, Work of the (N. A. C. U. Convention)...........Jan. 44

C

California Portland Cement Co., Colton, Cal., * ....April 197
—Some Primitive Concrete Work in... ....June 299
Canal Zone, Roofing Tile in.........June 282
Cantilever Wall Forms with Small Units, * *Eq* ....Feb. 103
Car, A Rotary Dump, *..............May 257
Cars Solve a Difficult Problem, Industrial, * *Eq* ....Feb. 102
Carlinville, Concrete Road Cost Data, *.. ....Mar. 119
Cart, A New Tool, * *Eq*............Mar. 156
Ceilings, Fastening Machinery to Concrete, *I-C* ....June 288
Ceilings, Method of Repairing Holes in Concrete, * ....Mar. 144
—Repairing Concrete, from Above, *E*.. ....Mar. 113
Centering, A New Stud and Panel Wall, * *Eq* ....Mar. 156
—for Elevating Construction, * *C*..Mar. 128
—Supporting, on Frozen Ground, *E*.... ....Mar. 109
Chapel and Workshop, Concrete in House, * ....April 186
Chats, Marketing, for Concrete, *.....Jan. 15
Chelsea, Mass., St. Luke's Church, * *C*.... ....May 244
Chicago, Aiken System House in, *..Mar. 110
—Cement Show ....May 233
—Show has 132 Exhibitors—Should have More ....Feb. 87
Chimney Construction, Segmental, in France, * ....Jan. 32
—The Construction of Gravity Concrete, * ....Mar. 149
—on the Pacific Coast, A Concrete, *.. ....May 234
Church, Broadway Presbyterian, has Stone Trim, * ....Feb. 61
—Chelsea, Mass., St. Luke's, * *C*..May 244
—of Epiphany, Dorchester, Mass., * *C*.. ....May 244
—Window Tracery for Villa Nova, Pa., * ....April 194
Cincinnati Building Failure, *C*.......Feb. 79
Cinder Concrete for House Wall Construction ....Mar. 153
Clay Products, Brick and, Try Knocking Concrete, *E* ....Mar. 106
—Publishers Exhibit Craftiness, *E*.May 208
Coal Bin Construction, *I-C*..........Feb. 76
Code, Progress on New York Building... ....April 206
Cold Weather, Handling Concrete in, * *Eq* ....Mar. 154
College Shrine in Concrete, A, *....Feb. 83
Color of Concrete Products, *.......Jan. 6
—and Texture, House of Concrete Block Attractive as to, *...........June 207
Columns, One Mold to Produce Two Different, * *Eq*.................Mar. 155
—Double Concrete Walls with Tile, *.. ....Mar. 135
—Forms for, in Concrete Construction, * ....June 279
—Head, Metal, Forms, * *Eq*.......Feb. 97
—Protection of Corners of Interior, * *I-C* ....June 289
—Reinforcement, Intercepting Spirals as, * *Eq* ....June 302
—Report of Test of Reinforced Concrete, * ....Feb. 84
—Transverse Reinforcement for, *C*.Mar. 127
Conduit and Large Concrete Pipe, Comparative Efficiency of Monolithic, *I-C* ....June 289
Control-Beam, A New, *............Feb. 81
Conveyors, Pneumatic, for Concrete, * *Eq* ....Mar. 155
Cores for Concrete Building, Structural Steel, *I-C* ....Feb. 74
—for Floor Construction, Molding Sand. * ....May 213
—Plaster, for Floor Work, Field Made, * ....June 283
—Structural Steel, for Concrete Building, *I-C* ....Mar. 123
Corncribs, A Special Concrete Block for, * ....June 264
Cost of Concrete, *E*................May 207
—Data on Bridge Materials, Unit, *Eq*.. ....Feb. 103
—Figures, Road, *E*...............May 207
Cowell Portland Cement Co., Cowell, Cal., * ....April 196
Creosote Stains Concrete, *I-C*.......May 241
Crete, Ancient, Investigations of Use of Cement in ....Feb. 71
Crushers, Small, on Concrete Work, *C*... ....Feb. 79
Culvert Form, a New Bridge and, * *Eq* ....Mar. 157
Curb Bars, Pavement Armor Plates and, * *Eq* ....April 205
"Curing" Hollow Walls by Filling Them with Water ....June 268
Curing, Winter, in Products Manufacture, *I-C* ....Jan. 24

D

Damp-proofing Masonry Structures, *.Feb. 91
Dentistry, Tree ....Jan. 31
Derrick, A Cantilever-Swung Builder's, * *Eq* ....May 254
Design, Reinforced Concrete, *E*.....April 159
Determinator, The Paving...........Jan. 29
Ditches, Lining, with Reinforced Concrete * ....June 265
Doorway Suggestions for Concrete Houses, * ....Mar. 114
Dorchester, Mass., Church of Epiphany, * *C* ....May 244
Double Concrete Walls with Tile Columns, * ....Mar. 135
—Monolithic Walls, *.............May 233
—Wall Machine Construction, Additional notes on ....Mar. 148
—Walls and Tile Columns in House Construction, * ....May 218
Drainage and Foundation for Concrete Roads ....Jan. 30
Drilling Concrete for Sprinkler System, *I-C* ....Mar. 125
Drydocks, Concrete (N. A. C. U. Convention) ....Jan. 5
Drying-Out of New Buildings, *I-C*....Jan. 19

E

Electric Currents, Action of, on Concrete, * ....Mar. 132
Electrolysis in Concrete (N. A. C. U. Convention) ....Jan. 4
Elevator Construction, Centering for, * *C* ....Mar. 128
—Construction, Concrete Grain.....Jan. 41
Engineering Congress, An International, 1915 ....June 304
England, Concrete Block Farm Buildings Built Economically in, *......Mar. 142
—Concrete Block Houses in........Feb. 72
—Industrial Houses in, *.........Mar. 144
—The Work of Educating Skilled Labor in ....Feb. 91
Europe, Concrete Paving in, *I-C*....April 179
Expansion Bolt, The Van, *Eq*........Feb. 97
Explosives, Storage of, *I-C*..........Jan. 19
Extensometer Using Liquid, An, * *Eq*.... ....Feb. 96

F

Factory Design, An Example of Modern, * ....May 257
Failure at Cincinnati, A Building, *E*..Feb. 56
—The Cincinnati Building, *C*......Feb. 79
—in Engineering Design, A, *E*....April 160
—Not a Concrete, *C*..............Mar. 128
Farm Buildings, Concrete Block Built Economically in England, *.......Mar. 142
Fence, Construction of a Low-Cost Concrete, * ....April 178
—How to Build Concrete Wind-Break, * ....April 185
—Posts, Concrete, to Receive Staples, *Eq* ....April 205
—Reinforced Concrete, Built at Cost of 76 cents per Foot, *..........Mar. 116
—With Concrete Rolling Doors, *..April 169
Fire and Flood in Ohio, Through, * *C*.... ....June 292
Fires and Fireproof Construction, *E*..June 259
Fish Ponds, Concrete, *C*............Jan. 25
—Concrete, * *C*..................Mar. 127
Flood in Ohio, Through Fire and, * *C*... ....June 292
Floors, Boiler Tube.................June 299
—Concrete, in Soap Factory, *I-C*...Feb. 75
—Concrete, in Soap Factories, *I-C*..June 287
—on Concrete Base, Wood Finish, *I-C*.. ....April 179
—Construction, Molding Sand Cores for, * ....May 213
—Construction, Pre-Cast Beams and Concrete Tile in, *...............Mar. 153
—Design of Armored Tubular.....May 228
—Finish and Its Execution, Concrete... ....May 230
—Levels, Waterproofing Walls at, * *I-C* ....June 287
—Sleeper Anchor, * *Eq*..........Mar. 155
—Surface Course, Specifications for Concrete ....May 220
—of Tile and Concrete, *C*........Jan. 26
—Top Finish in Compression, Concrete, *I-C* ....April 181
—Top Finish in Compression, Concrete, * *I-C* ....May 238
—Wood Block, *Eq*................Feb. 95
—Work, Field-Made Plaster Cores for, * ....June 283
Flooring, Asbestone, *Eq*............May 255
—Mastic, for Industrial Plants, *Eq*.June 302
Flower Pots, Concrete, * *C*.........June 296
Flue Lining Wrapping with Paper, *I-C*... ....April 181
Forms for Monolithic Concrete Pipe and Manholes, * ....May 252
—Metal Column Head, * *Eq*.......Feb. 97
—Steel for Concrete Construction, *... ....Jan. 11
—Steel, for Concrete Construction, *.. ....June 279
—Steel, for Concrete Houses, *I-C*..Jan. 23
—Steel Wall, Units for Concrete Work, *E* ....Mar. 112
—Wall, for Elevator Construction..Jan. 42
—With Small Units, Cantilever Wall, * *Eq* ....Feb. 103
—With Vertical Joints, Steel Wall, * *Eq* ....May 255
Foundations, How to Lay Out Building Lots or, *....................May 251
Fountains, How Drinking, Are Made; What They Cost, *..........June 268
Furnace, Cement Mortar in Hearth and Boshes of Blast..............May 220
France, Poured Concrete Houses in, *.May 209
—Segmental Chimney Construction in, * ....Jan. 32

G

Gelatin Molds, *I-C* ....Mar. 126
Germany, Concrete Products in (N. A. C. U. Convention) ....Jan. 44
German Design of House Portals, *..Mar. 114
Germany, Manufacture of Concrete Products in, *..................April 187
Girders, Forms for, in Concrete Construction, * ....June 279
Golden State Portland Cement Co., Ore Grande, Cal. ....April 197
Grading Aggregates, *I-C* ....Jan. 21
—Aggregates, *C* ....May 246
Gravel Handling in Cold Weather....Jan. 10
—Washing Plants, *..............Mar. 129
Gravity, Let, Do the Work, *E*......Mar. 109
Greenhouse Benches, Metal Forms for, * *Eq* ....May 256
Grouting, Details of a Simple Equipment for, * ....Feb. 84

H

Highways, Concrete (N. A. C. U. Convention) ....Jan. 3
—Construction, Federal Aid in.....Feb. 88
—Suggests Improvements in New York. ....May 224
Hoist, A Trolley Extension, * *Eq*....Jan. 49
Hoisting and Placing Concrete at Low Cost, * ....June 282
Hoists, Power for Contractors', *I-C* .Jan. 22
Homes, Concrete, for Everybody, *E*..Mar. 105
House, A Concrete, May Have Walls of Beautiful Texture, *..........Mar. 107
—A Concrete, of Unique Design, *.June 263
—Aiken, System in Chicago, *.....Mar. 110
—at Leesburg, Ind.. Concrete Block. *.. ....April 170
—at Owen Sound, Ont., *........April 170
—at Oyster Bay, Cut Cast Stone in, * ....Mar. 108
—Builder, A Word to Mr. Concrete, *E* ....Mar. 106
—Building, A Year in Concrete, *C*.April 182
—Building a Concrete, on Hillside, *.. ....Mar. 134
—Built of Concrete—To Resist Fire Attack, * ....Mar. 143
—Built of White Face Block, *....June 298
—Concrete Brick Veneer and Stucco, * ....Mar. 121
—Concrete Stone Veneer, at Syracuse, * ....Mar. 110
—Construction, Fireproof, *........Jan. 40
—Construction, Pumice Concrete Slabs for, *E* ....Mar. 112
—Costing $4,200, Details of Concrete Block and Stucco, *..........April 191
—Double Wall Concrete at Smith Town, L. I., *....................Mar. 109
—of Concrete Block Attractive as to Color and Texture, *............June 297
—of Stucco and Lime Rock, * *C*...May 242
—Poured Concrete, at Albany, *..Mar. 110
—to Cost $3,000, Poured Concrete, * *C* ....Feb. 80
—Wall Construction, Cinder Concrete in ....Mar. 153
Houses at Low Rentals, Concrete, * *C*.. ....April 183
—Building Concrete, *I-C*.........Mar. 126
—Concrete Block, Built for $1,500 each, * ....Mar. 138
—Concrete Block, in Italy, *......Mar. 111
—Doorway Suggestions for Concrete, * ....Mar. 114
—Fireproof on Western Plains, *..Mar. 115
—for Everybody, Concrete, *E*......Feb. 55
—for Mine Workers at Nanticoke, Pa., Concrete, * ....April 173
—Forms for, *I-C*.................Jan. 23
—Industrial, in England, *........Mar. 144
—in England, Concrete Block, *...Feb. 73
—in France, Poured Concrete, *..May 209

—in Industrial Village on Garden Lines .... Mar. 136
Housing Problem in Paris, Solving...June 267
Hudson's Bay $2,500,000 Store at Vancouver .... Mar. 151

I

I-Beams, Wrapping, *I-C*..........May 237
—Tying Concrete Around, *E*......June 261
—Wrapping, * *I-C*..........Feb. 75
—Wrapping, *I-C* ....April 180
Illinois Concrete Roads, Cost Figures on Four, * ....May 223
India, Reinforced Concrete Siphons in... .... April 190
Inland Portland Cement Co., Metaline Falls, Wn. ....April 197
Inn, Asheville, N. C., General Features of Mountain, * ....May 229
Inspection of Reinforced Concrete....May 235
Inspectors on Concrete Construction, *E*... .... May 208
International Association for Testing Materials, Meeting of ....April 206
Iowa Association of Cement Users, The.. .... Feb. 99
Irrigation Ditches, Lining with Reinforced Concrete, * ....June 265
Italy, Concrete Block Houses in, *...Mar. 111

J

Jamaica, Floating Concrete Buoys in, * *C* .... April 186
Jointless Concrete Road, New York State, * *C* ....June 295
Jones Falls, Enclosing, Baltimore in Concrete, * ....Mar. 117

L

Laitance in Concrete Work, The Nature of .... May 228
—in Sea-Water Concrete, *C*........May 242
Lampblack, Glare from Concrete Pavement Avoided by, *..........Mar. 150
Lamp Posts, Ornamental Concrete, *.May 226
Language, Foreign, as a Tool in Engineering Training ....Mar. 145
Lime Manufacture, Books on, *I-C*....May 238
—Rock, House of Stucco and, * *C*..May 242
Lincoln Memorial, *E*..........Feb. 55
Loft Building, New, Memphis, Tenn., *.. .... April 177

M

Machinery. Fastening, to Concrete Ceilings, *I-C* ....June 288
Manholes, Forms for Monolithic Concrete Pipe and, * ....May 252
Mantel Molds, Concrete, * *Eq*........Jan. 50
Manufacturing Concrete, *E*..........April 159
Manure Pits, Concrete, Readily Built at Moderate Cost, *..........Feb. 86
Marble, Artificial, *C*..........June 295
Marbles, Artificial ....May 227
Mastic Flooring for Industrial Plants, *Eq* .... June 302
Materials, Washing Concrete, *I-C*....May 238
Measuring Concrete (N. A. C. U. Convention) ....Jan. 5
Memphis, Tenn., New Loft Building at, * .... April 177
Metal Fabric. Lock-Form, * *Eq*......Jan. 52
—Lock-Form, * *Eq* ....Feb. 97
Metal Lath, The Development of, * *Eq*... .... April 200
Milwaukee, Concrete Road Construction Near ....May 221
Mine Tailings, Marketing, for Concrete, * .... Jan. 15
—Work, Concrete in (N. A. C. U. Convention) ....Jan. 5
Mixer, The Big-an-Little, * *Eq*.......Feb. 95
—A Hand Winch on a, * *Eq*......May 254
—Proportioning Mechanisms in Continuous, * *Eq*..........April 202
—A Small Batch, * *Eq*. ....May 255
—With Stationary Drum, * *Eq*.....Feb. 94
Mixing is Becoming a Lost Art, Hand-. *E* .... Feb. 56
—Concrete for Paving, Cost Data on.. .... Mar. 126
Mixer, Paving, * *Eq*..........June 300
Mixing Procedure, *I-C*..........Feb. 76
Molds, Gelatin, *I-C* ....Mar. 126
—Plaster of Paris, *I-C*..........April 180
Monuments, * ....May 225
Mortar for Stucco and Plaster, Colored, *I-C* ....April 182
Motor Trucks in Engineering and Contracting, Economy of.........April 194
—in Heavy Contracting, The Use of, * .... Feb. 89
Motor Truck Performance..........May 258

N

National Association of Cement Users, *E*.. .... Jan. 2
—of Cement Users, Convention of..Jan. 3
—of Cement Users 1914 Convention.May 218
—of Cement Users, Specifications of... .... June 299
New York Building Code, Progress on.... .... April 206
—Highways, Suggests Improvements in .... May 224
—State Jointless Concrete Road, * *C*.. .... June 295
Niagara Falls, N. Y., An Illustration of Rapid Building at, *..........April 175
North Carolina House with Double Monolithic Walls, *..........May 233

O

Oil, Tanks for Vegetable, *I-C*.......Mar. 124
—Tanks for Vegetable, *I-C*........June 287
—for Waterproofing, *I-C*..........Feb. 75
Oklahoma Concrete Houses, *.......Mar. 115
Onondaga Litholite Co., Concrete Products Factory, *..........Feb. 64
Ornamental Concrete, in Belgium, *..Feb. 101
—Concrete Products—Suggestions from Germany, * ....June 304
—Lamp Posts, *..........May 226
—Products Made at Minnesota Plant, * .... Jan. 14
—With Relation to Its Environment, * .... Jan. 16
Ornamental Rubble Posts, *I-C*.......Jan. 21
Owen Sound, Ont., House at, *.....April 170
Oxy-Chloride Cement, *C*..........April 184
—Cement Formulas, *E*..........June 261

P

Pacific Coast, Cement on the, *I-C*.....Jan. 23
Pacific Coast, Growth of Cement Industry on, * ....April 196
Pacific Portland Cement Co., Cement, Cal., * ....April 197
Paints for Concrete..........May 241
Painting Concrete Surfaces, Methods in .... May 232
—Structural Steel, *C*..........May 243
—Structural Steel Frame, *E*........Jan. 2
—Structural Steel Frame, *C*.......April 183
Panama Canal Information, *I-C*......April 182
Panels as Form Units, Recessed Steel, *.. .... May 250
Paris, Solving the Housing Problem in... .... June 267
Partitions, Fire Resistance of (N. A. C. U. Convention) ....Jan. 4
Partition Walls, Sound-proof Tile, *I-C*.... .... Jan. 21
Patents in Design and Construction (N. A. C. U. Convention)..........Jan. 3
Pavement Armor Plates and Curb Bars, * *Eq* ....April 205
Pavement, Glare from Concrete, Avoided by Lampblack, *..........Mar. 150
—Methods of Repairing ....Feb. 88
—Tests, Some, *E*..........June 259
Pavement Slab Tested, Four-inch Concrete .... May 220
—Vibrolithic Concrete, *..........Feb. 72
Paving, Cost Data on Mixing Concrete for ....Mar. 126
—Determinator ....Jan. 29
—in Europe, Concrete, *I-C*........April 179
—Slabs, A Severe Test of, *.....June 270
Paving Mixer, * *Eq*..........June 300
—One- and Two-Course Work in Concrete ....May 236
Pecora Cement, *I-C*..........Feb. 76
Pergola, * ....Jan. 17
Piles, Economy of Concrete, *I-C*.....Feb. 77
—Protecting, Against Teredos and Limnoria, * ....Mar. 152
Pipe, Comparative Efficiency of Monolithic Conduit and Large Concrete, *I-C*.. .... June 289
—Concrete Pressure ....Feb. 85
—and Manholes, Forms for Monolithic Concrete, * ....May 252
Pittsburg Cement Show, ...*E*.......Jan. 1
—Cement Show and Its Influence..Jan. 45
Placing Concrete at Low Cost, Hoisting and, * ....June 282
Plaster Cores for Floor Work, Field Made. * ....June 283
Plaster of Paris Molds, *I-C*........April 180
Poles, Method of Protecting Wooden, Against Decay, *..........Mar. 148
Ponds, Concrete Fish, * *C*..........Mar. 127
—Fish, *C* ....Jan. 25
Porch Construction, Use of Concrete in* .... Jan. 18
Porch, Cost of Concrete*..........Jan. 18
Position of Reinforcing Steel........Feb. 87
Posts, Ornamental Concrete Lamp, *..May 236
—Ornamental Rubble, *I-C*........Jan. 21
—to Receive Staples, Concrete Fence, *Eq* .... April 205
Poured Concrete House at Albany, *.Mar. 110
Poured Concrete Houses in France, *.May 209
Power for Contractors' Hoists, *I-C*...Jan. 22
Production of Cement Since 1880....June 298
Products Field, New Lines in Concrete, * .... May 225
—Development of Concrete, *E*.....May 207
—in Germany, Concrete (N. A. C. U. Convention) ....Jan. 44
—in Germany, Manufacture of Concrete .... April 187
—Manufacture, Winter Curing in, *I-C*.. .... Jan. 24
—Manufacturers, *E* ....April 159
—Ornamental Concrete, Suggestions from Germany, * ....June 304
—Plant, The Well Equipped, *E*...Mar. 106
—Plants, Winter Work in, *......Jan. 9
—Possibilities of Factory-Made, *..Mar. 108
—Sculptured Concrete Made at Minnesota Plant, *..........Jan. 14
—Surface Treatment of Concrete, *.Jan. 6
—Window Tracery for Villa Nova, Pa., Church, * ....April 194
Profit-Sharing in an Architectural Firm.. .... Mar. 153
Pumice Concrete Slabs for House Construction, *E* ....Mar. 112

R

Railway Shop Construction in Savannah, * .... Mar. 151
Railroad Work, Concrete in, *........Jan. 37
—Concrete in (N. A. C. U. Convention) .... Jan. 5
Raw Material for Portland Cement..June 286
Reclamation Work in the Heart of a City, *E* ....Mar. 111
Riverside Portland Cement Co., Riverside, Cal. ....April 197
Roadbed for Track Construction, Concrete, * ....April 170
Road, Carlinville Concrete, Cost Data on, * .... Mar. 119
—Congress, American, to be Held in Detroit ....June 303
—Construction Near Milwaukee, Concrete ....May 221
—Cost Figures, *E*..........May 207
—New York State Jointless Concrete, * *C* ....June 295
—Specifications for (N. A. C. U. Convention) ....Jan. 4
Roads, Concrete, Michigan and Elsewhere .... June 271
—Concrete, of Wayne County......Jan. 29
—Cost Figures on Four Illinois Concrete, * ....May 223
—Demonstration ....Mar. 120
—Expansion and Contraction of, *..Jan. 31
—Good, and the Cost of Living....Jan. 17
—Measurement of Expansion and Contraction, * ....Jan. 31
—(N. A. C. U. Convention).......Jan. 3
—on Concrete Base in King County, Wn., Three Types of Country.April 192
Roof Construction, * *Eq*..........Feb. 96
—Permanent, * *Eq*..........Jan. 47
Roof, Waterproofing An Old, *I-C*....Mar. 124
Roofing Tile in Canal Zone..........June 282
Roofs, Sweating of Concrete, *I-C*.....Feb. 75
Rubble Posts, Ornamental, *I-C*.......Jan. 21

S

Sand, An Ingenious Outfit for Screening, * .... Feb. 60
—and Gravel Washing Plants, *...Mar. 129
—Cores for Floor Construction, Molding, * ....May 213
San Gabriel Mission, Baptismal Font, *.. .... June 299
Santa Cruz Portland Cement Co., *..April 196
Sash, Sliding Steel, * *Eq*..........Jan. 49
Sauerkraut, Concrete Tanks for, *I-C*..Jan. 24
—Concrete Tanks for, *I-C*.........June 287
Savannah, Railway Shop Construction in, * .... Mar. 151
Saw Rig, A Portable, * *Eq*..........Feb. 97
—A Timber, on Building Work, *E*.June 261
Saw Rigs, Portable, on Construction Work .... Mar. 133
School, Concrete Block, * *C*..........May 247
—Concrete Block Walls of, Resist Fire Attack, * ....Jan. 46
Screening Outfit, An Ingenious Sand, *.. .... Feb. 60
Sculptured Concrete, *..........Jan. 6
—Concrete Products Made at Minnesota Plant, * ....Jan. 14
Sea-Wall is Built of Unit Concrete, *... .... June 278
Sea-Water, Concrete Deposited Under, *.. .... Feb. 65
—Concrete 50 Years in..........Jan. 37
—Concrete, Laitance in, *C*.........May 242
Segmental Chimney Construction in France, * ....Jan. 32
Septic Tanks for Sewage Disposal, Concrete, *I-C* ....April 181
Sewage Disposal, Concrete Septic Tanks for, *I-C* ....April 181
Sewers, Uses of Steel Forms on, *...Jan. 11
Shop-Building, Construction of an 8-Story, * ....Feb. 57
Shovel, Technique of the, *E*..........May 208
Shovels, Yankee-Toothed, * *Eq*.......Jan. 51
Show, Chicago Cement..........May 233
—Chicago, Has 132 Exhibitors—Should Have More ....Feb. 87
—Pittsburg Cement, *E* ....Jan. 1
—Pittsburg Cement, and Its Influence .... Jan. 45

Shows, Some Preference as to Coming Cement ....May 249
Sidewalk, Cost of Concrete, _I-C_......June 290
—Cracks in Concrete, * _I-C_.......April 180
—Cracks in Concrete, _I-C_..........Feb. 76
—Cracks in Concrete, * _I-C_.......May 239
—Discussion (N. A. C. U. Convention) ....Jan. 3
—Slabs, Factory Made, _C_.........May 247
—Slabs Used in Minneapolis, Factory Made ....April 172
—Specifications for (N. A. C. U. Convention) ....Jan. 4
Silo, Computing the Cost of a Concrete, * _Eq_ ....Feb. 100
—Construction, Concrete in, * _Eq_.April 201
—Stave Machine, * _Eq_...........June 301
Singapore, Fire Test on Concrete Tank at, * ....Mar. 150
Siphons in India, Reinforced Concrete... ....April 190
Slabs, Unit, for Wall Construction, * _C_.. ....Jan. 26
Slag, The Use of, as a Concrete Aggregate, _E_ ....Mar. 106
Sleeper, A Floor, Anchor, * _Eq_......Mar. 155
Small Work, Handling Economically, _C_.. ....Feb. 78
Soap Factory, Concrete Floors in.....Feb. 75
—Factories, Concrete Floors in, _I-C_... ....June 287
Specification Practice, Reform in Construction ....June 286
Specifications of the National Association of Cement Users ....June 299
Spouting Concrete, _Eq._ ....Feb. 99
Spraying Concrete Block Face Up, _C_ ....April 183
—Freshly Made Block, _C_...........Jan 25
Sprinkler System, Drilling Concrete for, * _I-C_ ....Mar. 125
Standard Portland Cement Co., Napa Junction, Cal ....April 197
Statuary, Restoring with Concrete, *.April 187
Stave Machine, A Silo, * _Eq_........June 301
Steel Frame, Painting Structural, _C_.April 183
—Frame, Painting Structural, _E_....Jan. 2
—Power Belting Increases Abroad, Use of ....May 225
Step Form Making for Economical Work, * _Eq._ ....May 253
St. Luke's Church, Chelsea, Mass., * _C_.May 244
Stone, Concrete Cast in Oyster Bay House, * ....Mar. 108
—Concrete, Veneer House at Syracuse, * ....Mar. 110
Storage of Cement in Winter, _I-C_....Jan. 19
—of Explosives, _I-C_ ....Jan. 19
Store, Hudson's Bay $2,500,000, at Vancouver ....Mar. 151
Street Signs, * ....May 225
Stucco Coat on Old House, A New Concrete Wall and, *.............May 235
—Concrete, _C_ ....Feb. 79
—House Costing $4,200, Details of Concrete Block and, *...........April 191
—House, Concrete Brick Veneer and, * ....Mar. 121
—Mixtures, Lean, With Waterproofing Compound, _Eq._ ....June 300
—Prepare, and Facing Mixtures, _Eq._ ....Mar. 158
—Roughening Walls for, _I-C_.......Mar. 125
—Specifications (N. A. C. U. Convention) ....Jan. 4
—Trowel, A New, * _Eq._ ....Jan. 51
—Walls, of Beautiful Texture, *...Mar. 106
—and Lime Rock, House of, * _C_..May 242
—and Plaster, Colored Mortar for, _I-C_ ....April 182
Superior Portland Cement Co.........April 197
Surface Finish in Bridge Work, Cost of, _C_ ....Feb. 78
Surfaces, Painting Concrete ....May 232
Surface Treatment of Concrete Products, * ....Jan. 6
Surfacing Material, Artistic, _Eq._....April 205
Surveying Instruments ....Mar. 151
Sweating of Concrete Roofs, _I-C_ .....Feb. 75
Syracuse, Concrete Stone Veneer, at, * ....Mar. 110

T

Tamper, A. for any Mold Box. * _Eq._Mar. 157
—for Brick Machine, * _Eq._........Mar. 157
Tanks, Concrete, for Sauerkraut, _I-C_..June 287
—for Sauerkraut, _I-C_ ....Jan. 24
Tank, Fire Test on Concrete, at Singapore, * ....Mar. 150
Tanks, The Use of Concrete for Tanning, ...May 247
—for Vegetable Oil, _I-C_ ....Mar. 124
—for Vegetable Oil, _I-C_ ....June 287
Tannery Buildings in Reinforced Concrete, * ....April 171
Tanning Tanks, The Use of Concrete for, ...May 247
Tenement, Three-Story, Built of Concrete With Wall Machines, * ....Jan. 43
Test Beam Equipment, A, *..........Feb. 81
Testing Methods (N. A. C. U. Convention) ....Jan. 44
Tests, Building (N. A. C. U. Convention), ...Jan. 5
—of the Strength of Cement.......May 257
Texture, A Concrete House May Have Walls of Beautiful, *.........Mar. 107
—of, Concrete Products, *.........Jan. 6
—House of Concrete Block Attractive as to Color and, *............June 297
Theses Worth While? Are College, _C_ June 293
Tile Columns, Double Concrete Walls with, * ....Mar. 135
—Columns in House Construction, Double Walls and, * ....May 218
—Hollow Concrete, _C_.............April 184
—How to Sell Clay, in Iowa is the Question, _E_ ....June 261
—Machine, A Compact Power, * _Eq._ ....April 203
—Making 42-in. Concrete, *........Jan. 9
—Partition Walls, Sound-proof, _I-C_ Jan. 21
—Pre-Cast Beams and Concrete in Floor Construction, *...............Mar. 153
—Roofing, in Canal Zone ....June 282
—and Concrete Floors, _C_..........Jan. 26
Tiling, Concrete Finish to Resemble, _I-C_ ....June 289
Time Record in Building, _C_.........April 183
Tombstone in Central Newfoundland, Home Made, * ....April 176
Transit and Level, A Combination, * _Eq._ ....Feb. 94
Tree Dentistry ....Jan. 31
Tree in Thoroughfare, A Concrete Guard to Protect, * ....May 247
Trowel, A New Stucco, * _Eq._........Jan. 51
Tunnels, Uses of Steel Forms on, *..Jan. 11

U

Unit Chimney Construction in France, * ....Jan. 32
—Concrete, Sea-Wall is Built of, *.... 278
—Construction, Development in, *..Feb. 67
—Construction (N. A. C. U. Convention) ....Jan. 5
—Slabs for Wall Construction, * _C_ Jan. 26
Universal Portland Cement Co. Plant at Duluth ....April 206
Utah, University of, College Shrine at * ....Feb. 83

V

Vancouver, Hudson's Bay $2,500,000 Store at ....Mar. 151
Vaults, Concrete Burial, * _Eq._........Jan. 54
Viaduct for Heavy Service, A Reinforced Concrete, * ....April 161
Villa Nova, Pa., Church, Quickly Made Window Tracery for, *.......April 194

W

Wall Construction, Unit Slabs for, * _C_ ....Jan. 26
Walls, Forms for, in Concrete Construction, * ....June 279
—System Using Concrete Window Frames, * _Eq._ ....April 202
—and Stucco Coat on Old House, A New Concrete, *.............May 235
Wanted—A Word, _C_ ....May 242
Washing Concrete Aggregates, _I-C_....Feb. 76
—Concrete Materials, _I-C_ ....May 238
—Plants, Sand and Gravel, * .....Mar. 129
Washington Portland Cement Co., Concrete, Wn., *................April 197
Waterproof Cement, _Eq._ ....Feb. 99
Waterproofing a Boiler Pit, _I-C_.....Jan. 24
—a Boiler Pit, _I-C_ ....Mar. 123
—an Old Roof, _I-C_...............Mar. 124
—Compounds, Bonding Values of, _Eq._ ....Mar. 154
—Compound with Lean Stucco Mixtures, _Eq._ ....June 300
—Compound, "Dri-Crete," _Eq._.....June 303
—Job, A Difficult, * _Eq._ ....Feb. 104
—Materials, Bond in, _Eq._ ....April 200
—Methods for Testing Concrete, *..Jan. 35
—Oil for, _I-C_ ....Feb. 75
—Values (N. A. C. U. Convention), ...Jan. 4
—Walls at Floor Levels, * _I-C_.....June 287
Wayne County, Concrete Roads of....Jan. 29
Wayne County Roads ....June 271
White Cement in England, Medusa, * _Eq._ ....Feb. 99
Whitewash, Light House, _I-C_.........May 239
Window Frames, A Wall System Using Concrete, * _Eq._ ....April 202
—Tracery of Concrete, * _C_........May 244
—Tracery for Villa Nova, Pa. Church Quickly Made, * ....April 194
Winter, Storage of Cement in, _I-C_ ...Jan. 19
—Work in Products Plants, * .....Jan. 9
Wire Straightener and Cutter, An Automatic, * _Eq._ ....Feb. 95
Wood, Preserving, in Concrete, _I-C_..June 290

Concrete-Cement Age

Vol. II JANUARY, 1913 No. 1

Editorials

IT IS HARD to estimate the value of a Cement Show a month after it closes. Many exhibitors, and many more visitors, at the recent Pittsburgh Cement Show expressed the opinion that December is too early in the winter for such a show. This, we believe, is true, so far as it concerns individuals actively engaged in the manufacture, sale and use of Portland cement. The average contractor goes to a cement show with the idea of keeping abreast of the industry. He wants to see the new developments and perhaps to apply new methods to his work next season.

In December many builders are just finishing the season's work. In any event the average contractor doesn't want to buy equipment in December and let it lie idle until the following April or May. He is inclined to order his machine the day before he actually has to have it and he wants it on the job the next morning.

While the attendance at the Pittsburgh show was not great, those who came saw plenty to interest. No man can say now what the ultimate results will be from the exhibitor's standpoint. The Pittsburgh district is new territory, not only for cement shows, but also, in lesser degree, for concrete construction as it is known east and west. The cement show planted seed which we think will produce business down there. It certainly spread the gospel of concrete in a new land, which is bound to benefit the entire industry.

* * *

A WORD to cement show exhibitors. The cement shows we now have are not perfect. No man nor set of men can run a big exhibition without a hitch. The whispered statement that the Cement Products Exhibition Co. "makes a good thing out of these shows" we believe is totally unjust. It is claimed, and we believe this, too, that the promoters never made a cent out of the shows. The profits, if there be any, are turned back into a fund to make the next show a better one. If there be a deficit, the exhibitors at large are not in any way responsible—that risk is taken by the cement companies and other interests that back the shows.

The average exhibitor is prone to complain that "the general public is flocking in to the show" and that therefore his exhibit is useless. A manufacturer of forms for building concrete steps is likely to take the thoughtless attitude that a man and a woman who want to build a house, are not interested in step forms—they will never buy any forms, nor cement, nor reinforcing, therefore why talk to them?

But it must always be remembered that this man and this woman, and thousands of other casual visitors at the cement shows, go away enthused over the possibilities of concrete construction. When they build they won't listen to an architect who doesn't advise concrete. *They* are the people who demand concrete steps and it is this demand, multiplied time and again, all over the country, that makes it advisable for the contractor who actually builds these houses, to buy step forms. The demand for step forms is the life of this exhibitor's business, but it is always the direct result of a demand for concrete steps.

So an exhibitor can't figure his show profits by this season's orders—some of his benefit, though later in coming, is just as certain. And the cement companies' exhibits

—the wonderful collections of pictures and drawings and actual concrete products—that attract the general public, result in ultimate good for every exhibitor who occupies space on the floor.

* * *

Concrete Among the Ancients

Indicative of the venerable age of the concrete industry is the interest taken in the subject by expert archaelogists. Writing in the *American Journal of Archaeology,* E. B. Van Deman makes an interesting summary of work done by the Romans in the thousand years between 750 B. C. and the year 300 of the Christian era.

Concrete, according to the author, did not come into use until about 200 B. C. The first uses of it were evidently confined to monumental structures. At first is was used for foundations and for backing of decorated and decorative surfaces only, but at about the beginning of the Christian era, its use had assumed such proportions that it was the principal building material.

The Romans made use of lime and puzzolana, with varying aggregates, like stone, brick and broken tile. In the time of Julius Caesar, concrete was fairly common and under Augustus Caesar, it became nearly universal. Facings were commonly used in concrete construction.

Concrete mortar, in the era just before Christ, was made up of grayish and brownish puzzolanic sand and under-burned lime in small amounts, which was of rather poor quality, and crumbled easily. Under the Caesars, a reddish puzzolana was used,which made a cleaner and harder mortar. True to the spirit prevailing under his rule, Nero's era saw a retrogression in mortar, as well as in morals. The mortar in the time of Trajan and Hadrian was of high quality, but under later emperors it again became poor and comparatively unsatisfactory.

Fairly large pieces of tufa rock were used in the earliest concrete structures, the maximum dimensions often exceeding 1 ft. About the time of Augustus, broken tile and other debris began to be used as aggregate, which was generally comparatively small in size. In the beginning, the aggregate was placed irregularly, but when tile were used, they were ordinarily packed in close rows. Binding courses were used, at fairly regular intervals.

From being used at first as a filler, concrete grew to be a chief structural material—that which had formerly been the core forming the structural element. In the reign of Julius Caesar, a facing of small stones was often used. About 50 A. D., facing of triangular brick came into use. These were apparently made in the angular shape, for the purpose, and their use became so popular that brick-faced concrete grew to be a standard type of construction in Roman territory.

Van Deman's article is scholarly and interesting in the extreme, giving evidence, as it does, of careful study and close observation of ancient types of masonry and mortar.

* * *

National Association of Cement Users

The ninth annual convention of the National Association of Cement Users held in Pittsburgh, Dec. 10 to 14, brought together from many parts of the country, men who are devoting their best efforts to the design and construction of better concrete. The work actually covered by the ninth convention is described elsewhere in this issue. It was interesting and valuable to a high degree.

In considering the work of the Association more broadly, there are outstanding features in the Association's development which can not but attract attention. The first of these is the growth of the work done, and the personnel of the Association. Fathered at its start by manufacturers of concrete block and block machines, the Association in growing, has included all lines of concrete construction and engineering until at the present time it is today practically a great engineering society, without, however, losing sight of the practical details of manufacture and construction of everything concrete, from drain tile and ornamental work to bridges and buildings.

In this breadth of work, and a membership including engineers, manufacturers, contractors and professors, lies the strength of the Association. Its accomplishments are at once technical and practical, and the Standard Specifications, and Recommended Practice developed by the Association are of the greatest value to every man in the field.

The recent convention indicated a better grasp on the entire problem of concrete construction by individual members. The work of the Association in the last decade is beginning to show, almost intangible as yet, a real accomplishment, in unifying and correlating all concrete work. Each line of concrete activity is beginning to have its definite place as a part of the whole, and its relation to the whole is better understood.

At previous conventions there has been an indication of that struggle with competing materials to establish concrete on a basis of merit. The topics under discussion on the floor of the convention have from time to time, in years past, thrown light on the struggle going on in every community. Today the struggle is practically over. Concrete is an established, a standard material, and the men of the industry are settling down in an earnest and sincere endeavor to get out of their material the best that there is in it.

The present work of the Association, and the promise of the future mean much to the best development of the concrete industry. The Association organization is a clearing house, in which the best experience and knowledge of each member is summed up and made available for every member.

Painting Structural Steel Frame

Dry concrete, soft steel (structural grade only), necessity of veneer, and a painted reinforcement are a few of practices that reinforced concrete inherited from other lines of engineering construction which, in the last few years, have been practically eliminated. Dry concrete is used for sidewalk base course, both hard and soft steel are used, concrete buildings standing forth as concrete, are in evidence everywhere, and any proposal to paint the reinforcing steel would be received with surprise. This last point brings us to the matter in hand.

In a casual inspection of steel frame building, the H-section columns were particularly noticeable in that they showed three colors. The top of the column showed the bright red of the shop coat. The gray first field coat was carried up two-thirds of the way, and the bottoms of the columns, together with all of the structure below already in place, showed the black of the last field coat.

On the floor below, the forms were already going up for columns and beams. These, with the floor slabs, were to be of concrete, and the question naturally arises as to the actual necessity of painting the steel frame. Even the shop-coat might be omitted. It used to be required in some specifications that the reinforcing bars should be dipped or painted, but the developments of the past few years have entirely done away with the practice. Portland cement concrete is the best permanent protection for steel. Why introduce a layer of pigment and oil, a possible plane of cleavage, between the steel frame and the concrete floors and columns? Isn't it possible that concrete could protect the steel frame as well as the reinforcing steel?

In the work of the Long Island Railway short tie-blocks were laid in the invert of the subway. These tie-blocks were impregnated with creosote according to usual custom, but it was found that the creosote in the tie would disintegrate the adjacent concrete in the invert. For a depth of about ½-in. around the tie the concrete was as soft as maple sugar.

In speaking of the disadvantages of a hardwood floor over concrete for wearing surfaces, Leonard C. Wason, president of the Aberthaw Construction Co., Boston, remarked that besides the cost there is the added dead weight of the screeds, cinder fill, under floor, and upper floor. Dead weight adds to the cost of the supporting construction of the foundations and adds other costs besides that of the floor itself.

National Association of Cement Users

The Practical and Technical Men of the Concrete Industry Meet at Pittsburgh

The ninth annual convention of the National Association of Cement Users was held at Pittsburgh, December 10-14 last. The location for the convention was well chosen, and the attendance from the first was large and representative. The initial evening of the convention, following the usual more or less perfunctory opening addresses of welcome, was brilliantly marked by an address by Arthur P. Davis, chief engineer of the U. S. Reclamation Service, giving a brief summing up of the work of the government in reclaiming the arid lands of the West.

The convention was called to order by President Humphrey, and the address of welcome was made by City Solicitor, Chas. O'Brien, Pittsburgh, representing Mayor W. A. Magee. Following this, Julius Carstanjen, a cement products manufacturer of Duisberg, Germany, presented to the Association the greetings of the German Cement Users' Associations. The address of welcome on behalf of the architects of Pittsburgh was presented by Edward Stotz, Pres. of the Pennsylvania State Assoc. Amer. Inst. of Arch., who discussed briefly cement and concrete from the architect's view-point.

James O. Handy, Pres. of the Engineers' Soc. of Western Pennsylvania, in extending to the members of the Association a cordial welcome from the engineers of Pittsburgh, mentioned a personal incident which had tended to augment his regard for the strength and tenacious permanence of concrete. His family had expressed a desire for a rain-water storage tank and accordingly one had been built in the basement. This fell into disuse, and Mr. Handy removed it with a sledge hammer. The operation was arduous, to say the least. Hence his respect. Mr. Handy called attention to the fact that the Pittsburgh district is the largest producer of steel, and that Pennsylvania produces more cement than any other one state. The Association seemed, therefore, well-met in Pittsburgh. So far as cement production is concerned, the Pittsburgh district itself has 3 large mills. One of these, stated Mr. Handy, referring undoubtedly to the Wampum plant, is the lineal descendant of one of the oldest mills in the country. At the original Wampum plant, efforts were first made in 1874 to produce cement and in 1876, the efforts had been so far successful that this material was awarded a special prize at the Philadelphia Centeninal Exposition.

The contracting interests of Pittsburgh extended their welcome through James L. Stuart, and after a short business session in which the names of the committees on Nominations and Resolutions were announced, the evening was closed with the paper by Mr. Davis on the Reclamation work. An abstract of this paper appears elsewhere in this issue, but it should be said in passing that Mr. Davis, talking informally from about 100 vividly beautiful slides, gave a comprehensive idea of the wonderful work the Reclamation Service is doing. The work accomplished borders on the heroic. It is the sort of constructive conservation that inspires patriotism. All honor to the men who are spending their lives amid hardships and deprivation, putting through construction work against the greatest of handicaps, those of a wild and hitherto unconquered nature.

Sidewalk Discussion

The Wednesday morning session opened with an informal discussion on concrete sidewalk methods, mainly devoted to the comparative cost and value of 1- or 2-course work. Considerable interest was shown in the possibilities of 1-course work.

"Grouted" sidewalks, formed by tamping coarse aggregate in place and pouring a rich mix over and into it was also suggested in the discussion.

Concrete Bridges

The first work of the convention in session was to receive and discuss the report of the committee on reinforced concrete highway bridges and culverts, submitted by Willis Whited, chairman, Bridge Eng., Pennsylvania State Highway Dept. Tentative specifications, intended mainly to draw out discussion, were submitted, and were ably discussed. Among other things the specifications called for 75. lbs. per sq. in. compression in the concrete, or 37½% of total compression value. H. H. Quimby* in written discussion, urged that 30% be used instead. D. B. Luten† called attention to the fact that the specifications, as submitted, did not cover recommended construction practice. This report, however, is the first one the committee has made, and in later reports will differentiate between specifications and recommended standard practice Prof. A. N. Talbot (Univ. of Illinois), discussed the report with especial reference to the distribution of stresses across a slab or an arch; and E. S. Larned (Boston), brought in the question of patent rights in bridge design and construction, and the possible infringement of these rights. The usual practice, and apparently the best one in this matter, is to make the contractors responsible for any liability from the use of patented article or design. This matter was discussed in greater detail in a following paper.

Patents in Design and Construction

W. M. Denman, cons. engr. Springfield, Mass., under the title of "The Present Status of Patents Applying to Reinforced Concrete Construction," discussed the patent situation as applied to concrete structures only, without reference to the great number of patents which have been taken out on concrete machinery and equipment Between 1890 and 1900, 35 such patents were issued. Now they are being issued at the rate of about 150 per year. Buildings, bridges and retaining walls were discussed. and the principal patents relating to these structures presented with stereopticon illustrations. Mr. Denman took the stand that patentees were the expert engineers of the industry who should receive the reward of ability and genius by a temporary monopoly and control over the use of designs covered in the patent.

The discussion following this paper was very spirited; L. J. Mensch cons, eng., Chicago. describing the way in which some of the essential features claimed in the patents were presented in his books in schools 20 years ago. In reply to a question as to whether or not bridges could be designed without infringing patent rights, Mr. Denman replied that while they could be designed, they could not be designed economically unless following some patented design. Mr. Mensch replied that the claim that economical designs can not be effected without using proprietory designs was an offense to the engineering profession. As the time was short the discussion was closed by the chair, to allow the paper on Concrete Roads to be presented.

Concrete Highways

Edward N. Hines, road commissioner of Wayne County, Mich., presented a most interesting and vivid description of concrete road building operations. This was an informal talk accompanying a series of moving pictures, and made wonderfully plain the effective and economical work making for permanent pavements. This paper is published in other pages of this issue. Accompanying the paper and pictures on roads, the pavement testing machine described in the December issue was also shown in the "movies" and described by Mr. Hines.

The convention was enthusiastic over the work accomplished and the methods used, and following the paper, Mr. Hines answered questions covering many details of the work. A rising vote of thanks was accorded the speaker, for the work of spreading the gospel of better highways feels a shoulder at the wheel in the work done in Wayne County, Mich. Mr. Hines spoke briefly but earnestly and very much to the point.

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*Eng. of Bridges, Philadelphia.

†Concrete Bridge Engr., Indianapolis.

Road and Sidewalk Specifications

In the absence of C. W. Boynton, Chairman of the committee on roadways, sidewalks and floors, the committee report was read by H. H. Talbot. This report mainly consisted of changes adopted in the standard specifications for plain concrete floors. curb and gutter, and roads and pavements.

In the specifications for plain concrete floors, (paragraph 20) edgers with a ⅜-in. radius are specified instead of those with ½-in. radius. The specification as now worded, conforms more nearly with general practice. It is also recommended (para. 37) that floors be kept moist 6 days instead of 4, as in the former specifications. This same recommendation was made for reinforced concrete floors also, in a similar revision of clause 24 of that specification.

Edgers with ⅜-in. radius are recommended for curbs also (para. 33 of curb specifications). Revised specifications require that walks and curbs be kept wet for 4 days, and not opened for traffic until the engineer so directs.

In the pavement specifications, rather extensive changes were made. The most important of these are noted in the following paragraphs, wherein the changes made are in italic:

Joint Filler

7. The expansion joint filler shall be a suitable elastic waterproof compound that will not become soft and run out in hot weather, nor hard and brittle and chip out in cold weather. *Expansion joints may also be formed by inserting during construction and leaving in place, a total thickness of one-quarter (¼") in. of tarred paper or tarred felt.*

Expansion Joints

18. *Width and Location.—Expansion joints not less than 1/4" nor more than 1/2" in width* shall be placed across the street or road not more than twenty-five (25) feet apart, perpendicular to the center line. When a curb or combination curb and gutter is used, a *1/2-in.* joint shall be placed between it and the pavement. All expansion joints shall extend through the entire thickness of the pavement.

19. *Protection of Edges.*—Where required by the engineer in charge, the expansion joints shall be protected with metal. Unless protected by metal, the upper edges of the concrete shall be rounded to a radius of *three-eighths (⅜) in.*

Two-Course Pavement Base

25. *Placing.*—After mixing, the concrete shall be handled rapidly and the successive batches deposited in a continuous operation completing *sections between expansion joints without the use of intermediate cross forms or bulkheads.* Under no circumstances shall concrete be used that has partially hardened. The concrete shall be well tamped to a surface the thickness of the wearing course below the established grade of the pavement. Workmen shall not be permitted to walk on the freshly laid concrete, and if sand or dust collects on the base, it shall be carefully removed before the wearing course is applied.
than *twenty (20) ft.* wide not having car tracks, the pavement shall be re-

26. *Reinforcement.*—On streets more inforced with wire fabric or with plain or deformed bars. The cross-sectional area of metal shall amount to at least 0.041 sq. in. per ft. measured parallel to the axis of the street and at least 0.025 sq in. per ft. measured perpendicular to the axis of the street. The reinforcement shall be placed upon and slightly pressed into the concrete base immediately after the base is placed. Reinforcement shall not cross expansion joints and shall be lapped sufficiently to develop the strength of the metal.

28. *Consistency.*—The mortar shall be of a consistency that will not require tamping but which can be easily spread into position *with a template or a straight edge.*

Wearing Course

31. *Finishing.*—After the wearing course has been brought to the established grade, it shall be worked with a wood float in a *manner that will thoroughly compact it and produce a comparatively smooth surface, free from depressions or inequalities of any kind. The finished surface of the concrete shall not vary more than one-quarter (1/4) in. from a two (2) ft. straight edge placed upon the concrete in any position.*

One-Course Pavement

35. *Reinforcement.*—When a one-course pavement is to be reinforced, the metal shall be placed *at the middle of the section* of the pavement. The minimum amount of metal shall be as specified under two-course pavement.

Throughout the specifications for pavements and sidewalks, the 1:1½:3 mix is changed to 1:2:3. The coarse aggregate is specified to pass a 1-in. ring.

At the end of the pavement specification there is some omission and renumbering of paragraphs, and paragraph 37 (formerly 42) reads as follows:

37. *Treatment.—As soon as the concrete has hardened sufficiently to prevent being pitted, the surface of the pavement shall be sprinkled with clean water and shall be kept wet for at least four (4) days. Concrete pavement on roads shall be covered as soon after finishing as it is possible to do so without damaging the surface, with at least two (2) in. of dirt, which shall be kept wet for at least four (4) days. Before covering with dirt, the pavement shall be sprinkled with water as above specified. The pavement shall not be open to traffic until the engineer so directs.*

New paragraphs read as follows:

Shoulders

39. *Construction.—On streets where the pavement does not occupy the full width of the street, and on roads, a gravel or crushed stone shoulder at least two (2) feet wide shall be construction on each side of the pavement. The surface of the shoulders shall have a slope away from the pavement of one and one-half (1 1/2) inches per foot, and a thickness for the two (2) foot width adjoining the concrete at least equal to the minimum thickness of the concrete.*

40. *Construction.—Where a wearing surface of bitumen and fine aggregate is used, it shall preferably be placed upon a one-course pavement constructed as hereinbefore specified, but may be used also on two-course work.*

The changes were accepted, and the revised specification will be referred to letter ballot.

Electrolytic Action in Concrete

This was the title of an excellent paper prepared by E. B. Rosa, asst. dir.; Burton McCollum, assoc. physicist; and O. S. Peters, asst. physicist, U. S. Bureau of Standards, Washington, D. C. The paper read by Mr. McCollum and illustrated with stereopticon. described in detail accelerated electrolytic tests on concrete specimens and the relation of these findings to actual building construction. A very complete summing up of the subject was presented, and an abstract of this paper is published elsewhere in this or will be published in an early isue of Concrete-Cement Age. Three points are worthy of note and may be mentioned in passing. In any electrolytic action, the cement or concrete itself is in no way eliminated except in extreme cases, immediately adjacent to the reinforcing metal. Salt used in the water increases electrolytic actions, and is dangerous. The disruptive force of electrolysis is entirely mechanical. The estimated internal pressure developed by the electrolytic oxidation of the embedded iron bar was about 4,700 lbs. per sq. in.

Waterproofing Values

The next paper on the program, "Tests of Waterproofing for Concrete," was presented by Cloyd M. Chapman, engr. in charge of tests, Westinghouse, Church, Kerr & Co., N. Y. C. The paper was an excellent analysis of the technique of testing waterproofing materials, and appears practically in full, in other pages of this issue.

Fire Resistance of Partitions

L. H. Miller, engr. the Bethlehem Steel Co., Cleveland, described in detail the fire tests on different partitions conducted under the direction of the Building Department of Cleveland. A description of these tests was published in the August issue. Mr. Miller was followed by H. B. McMaster of the Assoc. Metal Lath Manufacturers, Youngstown. O., who emphasized in detail some of the points brought out in Mr. Miller's paper. The necessity of a National Testing Bureau was urged, and attention was called to the fact that there is now before Congress a resolution to provide the Bureau of Standards with sufficient funds to enable it to carry on extensive structural material tests. It is to be sincerely hoped that the income to carry on this work will be forthcoming, as the work of the Bureau of Standards should be extended in every way possible.

Stucco Specifications

The report of the committee on standard stucco specifications consisted in the main of slight revisions in the specifications as submitted last year. Much discussion centered around the use of wood lath. The committee at first reported in favor of painting lath with creosote or other preservative.

This was amended so that the lath might be dipped, instead of painted. Up to this point, most of the statements made had been based on conjecture, and as no one could cite satisfactory uses of wood lath and the accompanying methods, a motion was passed that all consideration of wood lath be omitted from the specification. Attention was called also to the danger of over-emphasizing the use of stucco on metal lath without taking under more thorough consideration the use of stucco on tile. A cement mortar was recommended for the scratch coat instead of lime mortar; the proportions of lime and cement were criticized; and the use of hydrated lime, as against lime putty was urged. So many points remained unsettled that the specification was laid on the table for further consideration at a later session.

Concrete in Mine Work

The president's annual address Thursday evening covered the progress in the use of concrete in mine work abroad. In Europe, labor is comparatively cheap and materials are high, and design methods and field practice follow somewhat different lines. The paper was of interest and value in showing the latest developments abroad in this field of work.

Concrete Drydocks

The paper on the use of concrete in naval yards and docks, was presented in the absence of its author, Rear Adm. H. R. Stanford, ch. engr., Bureau of Docks and Yards, Washington, by C. A. Carlson, civ. eng., U. S. Navy. The paper described in a most interesting way the extremely difficult work at Pearl Harbor, Hawaii, in placing concrete under water. An abstract of the paper appears elsewhere in this issue.

Concrete in Railroad Work

The first of the group of the papers on this subject was presented by M. A. Long, arch., B. & O. R. R., Baltimore. Mr. Long pointed out both the good qualities and the defects of concrete for railroad construction. Railroad structural problems change so rapidly that concrete, permanent as it is, offers certain drawbacks. On the other hand, it is so comparatively cheap and effective in every way, that it is becoming the material universal for railroad work. Mr. Long reviewed in general some of the interesting features of recent work. Among other things he described a water tank of concrete in which the water froze to a considerable depth when the concrete was comparatively new, resulting in some leakage. Soft coal cinders contain too much sulphur, and should be avoided for concrete work. At present, railroads seem to be using concrete for every structure, and in watch house, stock houses, etc., it has been utilized at less cost than wood. Mr. Long pointed out the need of better wearing surfaces for floors, and better ways of finishing wall surfaces. The talk was illustrated with lantern slides and was both interesting and instructive.

The grade-crossing problem was discussed in detail by James W. Phillips, asst. eng., Dept. of Public Works, Philadelphia. Over a short run of about 2½ miles of track through a thickly settled part of Philadelphia, the crossings have been separated, and many interesting methods have been developed. The coaling station described in the October issue was discussed in detail. Many stereopticon illustrations were used.

The Pennsylvania system is pushing across Long Island to Montauk Pt. with a wonderful freight and passenger handling system, and some of the concrete work between Jamaica and Brooklyn was described and illustrated by Friderick Ouryansen, ch. eng., Long Island R. R. Co. (The Pennsylvania System). The paper was an able and clear presentation of many interesting problems in railroad construction work, and will be found, practically in full, on other pages of this issue.

Concrete Bridges in Pittsburgh

Pittsburgh is well situated topographically for concrete arch bridge structures. The deep ravines afford plenty of rise for the arch and the native rock, comparatively near the surface, affords an excellent foundation. Norman S. Sprague, supt. of the Bureau of Construction, Pittsburgh Dept. of Public Works, gave an excellent address at the Thursday morning session on the concrete bridges recently completed and under construction by his department. The 3-rib Meadow Lane bridge, the 2-rib Larimer Arch structure,* now in service were illustrated and described. The Atherton Ave.† bridge was also covered in some detail.

Concrete, according to Mr. Sprague, is the ideal material for bridge construction. Paint, as a protection for steel in bridge structures, is expensive and, unsatisfactory. The architectural work on bridges falls under two principal heads. In the first place, the engineering lines, the essential features of the work can be so handled as to produce excellent and truly artistic and truly architectural results. Secondly, a bridge structure can be decorated with architectural ornamentation which has no relation whatever to the engineering structure. Concrete handled in this latter way is apt to be very expensive; but in a skillful application of sympathetic architecture to the engineering lines of the structure, wonderful effects can be secured at a minimum cost. Mr. Sprague urged better methods of surface treatment, and brought forward many very excellent points in bridge design and construction.

Business Session

The principal question before the convention was the matter of a standing deficit, and the best way of meeting it. At the present time the proceedings of the 8th Annual Convention (Kansas City, March, 1912), have not been published owing to lack of funds. The possibility of increased membership, of a large contributing membership and many other points were discussed. Mr. Humphrey has done excellent work in securing funds, but it seems very apparent that definite steps must be taken to place the Association in a position where men and money will come to it. The matter of placing the Association in a better position received the serious consideration of the members present. The point at issue, and generally recognized is the real necessity of the publication by the Association of a journal, appearing monthly if possible. This would keep the members in constant touch with the work of the Association, would make it much easier to get new members, and in every way, put the Association in a position to do more effective work. At a later session, a resolution was offered, and passed, authorizing the governing board to take immediate action toward such a publication. The convention accepted unanimously the report of the committee on Nominations, and the following officers were elected for the coming year: Richard L. Humphrey, Pres.; Arthur N. Talbot, Vice Pres. for 2 years; L. C. Wason, Vice Pres. for 1 year. A change was made in the by-laws, so that there is now 1 director from each of 6 districts as follows: Directors for 2 years, 1st Dist., W. L. Church, Boston; 4th Dist., W. P. Anderson, Cincinnati; 5th Dist., B. F. Affleck, Chicago;—directors for 1 year, —2nd Dist., E. D. Boyer, N. Y. C.; 3d Dist., E. L. Ransome, Dunellen, N. J., 6th Dist, Chas. Derleth, Berkeley, Calif.

Heinz Plant Excursion

Members of the Association were the guests of the H. J. Heinz Co. Thursday noon at a lunch and inspection trip through the factory. Men saw themselves as others see them, when at the close of the lunch and a brief explanatory lecture, a stereopticon threw on the screen a photograph of the party which had been taken on its arrival at the plant.

Measuring Concrete

A proposed standard method of measuring concrete was read by Robert A. Cummings, cons. engr. Pittsburgh, as a report of the committee working on this subject. With the exception of some revision, this report was practically as published in *Cement Age* for April last.

Unit Construction

A paper describing the present status of unit construction by John E. Conzelman, ch. eng. Unit Construction Co., St. Louis, was, in the absence of the author, read by Chas. D. Watson, Watson Eng. Co., N. Y. C. The paper reviewed the past development in this field of endeavor, and described recent work. Tests have been recently conducted on column head flanges to determine the comparative efficiency of different types of reinforcement. This matter will be found to be covered more fully elsewhere in this, or in a subsequent issue.

Building Tests

Arthur R. Lord, structural engineer,

(Continued on page 44)

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*See *Cement Age*, June issue.

†Page 69, October issue.

Color and Texture of Concrete Products[*]

Surface Treatment, Coloring By Immersion, Stone Dressing Methods Applied to Concrete

BY ADOLPH SCHILLING[†]

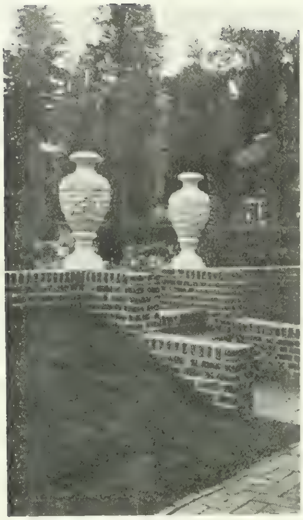

Fig. 1—Ornamental Vases for a Garden Entrance, Cast in Gelatine Molds

When, ten years ago, I started to make concrete attractive and pleasing to look at, I accepted as definitely settled its claim for strength and endurance, so thoroughly demonstrated by the engineers of our present time and by the examples of ancient concrete work still in existence.

My researches and experiments have been devoted entirely to giving concrete a complexion and the artistic qualities which would make it interesting to the architect and the decorator as a medium for embellishment and actual construction in their work. If, for this reason, my remarks are of less technical interest to engineers and contractors in concrete construction, I ask their indulgence, to consider concrete for a few minutes as something rather pleasing from the esthetic side and from the standpoint of utility.

Twenty years' practical experience among the natural stones used in monumental and building work, had enabled me to appreciate the conditions that must be met, to give concrete a place alongside the limestones, marbles, granites and metals, the familiar medium in which the architects had expressed their thoughts almost exclusively.

After once thoroughly understanding the qualities of cement as a binder or matrix one can learn to adopt our many mineral and metal products as readily as he uses the better known sand, gravel and crushed stone.

To produce color effects, we may use the gray and white Portland cements, either by themselves, or mixed in certain proportions, adding to this, suitable pigments. But, in many cases, the natural colored aggregates, sand, silica, pebble grits, marble and granite, will give excellent and more uniform results; it requires great skill and care, to mix properly cement and color pigments without reducing the strength of the cement, and to obtain uniform color effects.

The importance of mixing the pigment thoroughly with the cement, before adding the aggregates, should be appreciated by anybody attempting to make concrete in colors.

As a very simple method to test the proper amalgamattion of the pigment with the cement, take a handful of the mixture, and press it under a sheet of stiff paper. This will produce an even surface of the material, and as long as this surface does not show absolute uniformity in color, the mixing is incomplete. If small specks of color show on the surface under this test, these same specks of unassimilated pigment will appear in the concrete.

Some excellent work has been done recently in modeling in concrete, by artists who attained their efficiency in this method abroad. The most important work of this kind, to my knowledge, is a group of the Crucifixion, of heroic size, at Lynn, Mass. The artist builds up his design in concrete from a sketch model or cartoon. He is enabled by using a mixture of quick-setting and slow-setting cement, to regulate his medium. In this way he can give the work all the same freedom and spirit as if he modeled in clay, producing any texture desired; color effects can be obtained as desired, by using colored cement of various shades. For instance, a garland of flowers can be modeled in their natural colors and there is no difficulty in producing the well--known Della Robbia effects in concrete, just as is done in terra cotta. This method is particularly of interest and value where one piece only of a large ornamental design is to be used, thus avoiding the expense of molds and setting in place, and also preventing unauthorized replicas of original designs.

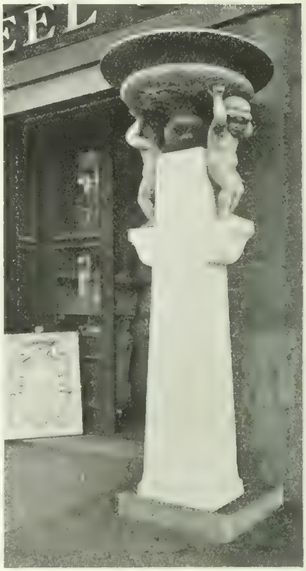

Fig. 2—An Ornamental Garden Vase Cast of Concrete

So far, a very important factor, which can be utilized to give color to concrete or cement, has been given little or no attention. While very simple in its primary action, its successful application requires thorough understanding of the principle and medium employed. The absorptive qualities of concrete during its stage of curing and seasoning, offer opportunities for coloring concrete products by capillary action. By this method, the color is deposited into the pores of the surface, amalgamating with the concrete in a permanent unit. The possibilities of this treatment are unlimited, but individual knowledge of coloring values and judgment, so as not to impair the strength requirements of concrete, are essential for success.

Coloring solution can be made to penetrate the surface of concrete six inches or more, if the object is placed in the solution in a very green state. It is rarely necessary to penetrate more than 1/32 in. to ⅛ in.; this thoroughly fills all pores, gives the desired color effects, and is less expensive.

Every atom of coloring matter absorbed by the concrete reduces the strength of the solution; and as some of the coloring matter used is quite expensive, good judgment in allowing

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[*] Presented before the National Association of Cement Users, Pittsburgh.

[†] Philadelphia.

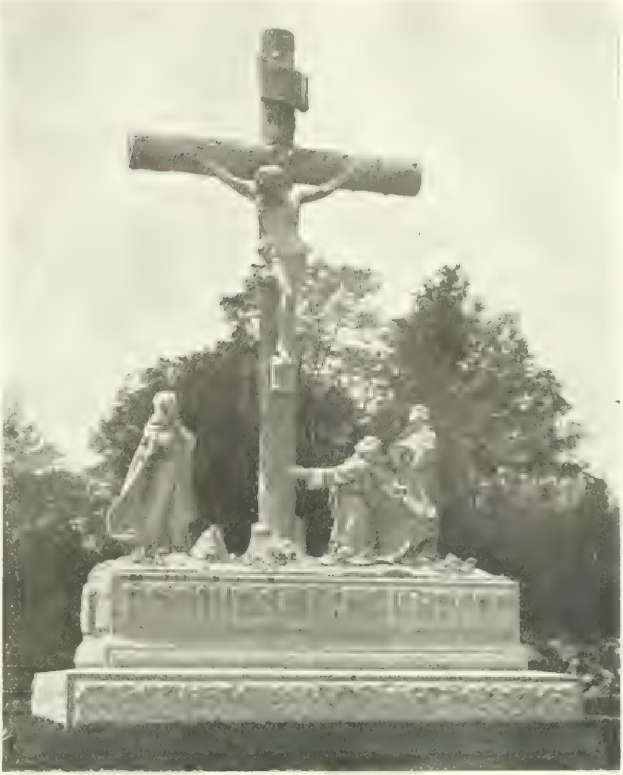

FIG. 3—A CRUCIFIXION GROUP IN "SCULPTURED" CONCRETE

This work is executed by methods very similar to modeling in clay. A rigid steel frame is built, approximating the framework of the group. This is covered with expanded metal, and several scratch coats of cement mortar bring the group to its approximate outline. The sculptor then, with different mixtures of quick-setting and slow-setting cement and selected sand, builds the statue, placing the concrete and modeling it delicately while soft, with spatula and pointing knife

In this group, which stands on a base 11'x19', the cross is 25' high and 12' across the arms. The figure of Christ is 9' 6" high. The group is 7' high

only the necessary absorption of coloring matter, is advisable from an economic standpoint.

Aniline color and the sulphates of copper and iron are the most suitable to make solutions in which to color concrete by the capillary method.

The concrete to be colored can be treated after it is several days old. Concrete products with strength requirement should not be subjected to the coloring bath until the concrete has attained its required strength, as the filling of the pores in the concrete stops the action of its curing by the usual methods.

Coloring by absorption is effective on surfaces of concrete after it comes out of the mold, or after being treated with acid or tools. Surfaces that have been colored by absorbing mineral or metallic colors become waterproof, and the action of the weather on the metallic colors is the same as on real metals, increasing the beauty of coloring by the usual oxidation noticed on bronze and copper. Surfaces of concrete treated by this method become so hard and dense that they will take a uniform dull or high gloss polish. I have treated such surfaces in the same manner as marble, granite and metal, under polishing or buffing machines.

Products made by my methods, such as flower pots, vases and boxes, will hold water after the second day of casting, and become so hard that when struck with a hammer they ring like a metal bell. I do not think waterproofing compounds are essential in obtaining this result, but consider the proper amount of water and thorough grading of the aggregates as all important .

I have made extensive tests in the last three years with waterproof paints, and have obtained excellent results. Ordinary concrete can be made very attractive by one or two coats, and if applied in stipple fashion it will not impair the grain or texture, avoiding the undesirable effect of painted stone.

This method is especially to be recommended for dry or semi-dry process concrete work, as the porous surface readily absorbs the waterproof liquid, and allows the pigment particles to fill the pores.

The color effect obtained in this manner is the most economical, but it is a flat color, and does not give the richness and depth of shading that results from the immersion treatment in an aniline or metallic color bath. It has the advantage, however, of being used in cases in which immersion is not practicable.

I have obtained excellent two- and three-color effects by painting certain parts of objects before subjecting them to the coloring bath. The parts so colored would not be affected by the color in the bath.

The artistic possibilities of such treatment are limited only by the color sense and taste employed by the craftsman. By using certain non-absorptive aggregates, their natural color can be retained, while the absorptive parts will assume the desired color. In this treatment, precaution must be taken not to use certain acids in washing before immersion in the color bath, as the chemical action of the acids is likely to counteract the color value of the bath.

Long practice and tests will give the experience necessary to gain the full benefit of this process; I have spent nearly 10 years to obtain the present results.

In the matter of surface finishes, considerable headway has been made, and most of the methods are well known to the progressive concrete man.

I find that concrete of proper age can be treated just like any natural stone, using the same tools and machinery to dress its surfaces and it is my strong conviction that the success of concrete stone for building purposes rests with a close affiliation of the stone-caster and the stone-cutter. In this way alone shall we be able to give concrete proper texture and the necessary qualities of dimension stone, so essential with the architect and builder.

For six years, my concrete stone and natural stone plant were under one roof, and I found that such conditions were ideal to procure a first class composite stone of proper size and finish.

The addition of a skilled stone-cutter and setter to every concrete products plant, would be a source of profit, and result in much better work. He knows what it means to have dimension stone true to size and shape. The average worker in cement or concrete does not appreciate this essential point, but it is all important with the architect and general contractor. The services of a stone-setter will enable the concrete products manufacturer to set his own work, which is very deisrable for good final results. The brick or natural stone mason for reasons of his own does not give composition stone the required care when setting it.

But once give this fraternity to understand that concrete stone means a medium of employment to stone-cutters and setters and their antagonism will vanish for the same reasons.

Whenever the opportunity affords, I

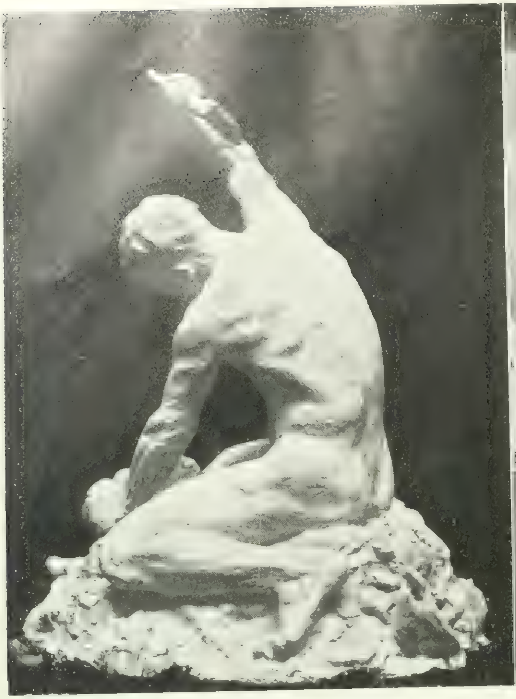

FIG. 4—THIS FIGURE WAS MODELED BY HAND AS DESCRIBED UNDER FIG. 3

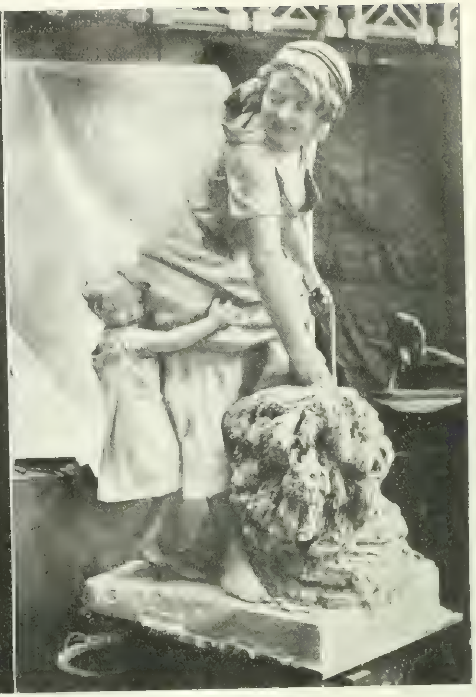

FIG. 5—THIS GROUP WAS CAST IN A PLASTER MOLD

strongly recommend closer affiliation of the composite and the natural stone trade.

The enormous increase in high class building operations, and the constant effort for betterment in the moderate price homes, give abundant fields for both trades in a better class of work, and at more satisfactory profits.

In my experience I found that every machine, tool and implement now used in finishing natural stone, could be employed to good advantage in dressing concrete products.

It has taken many years to perfect the business of dressing natural stone. The progressive concrete products man should study these methods and benefit by the experience of the man whose product he must equal, or improve upon, to meet approval by the architect.

To the manufacturer of or worker in concrete products, I further recommend the adoption of such methods as are employed in other lines of manufacture in treating the surfaces of his product. For instance, instead of applying the paint by brush, immerse the article in the paint; this is especially adapted for acid washing.

Tanks of sufficient size should be constructed in a concrete shop, and the soaking of concrete surfaces in acid will not only result in a great saving of acid, but produce a class of work that cannot be obtained with the scrubbing brush.

A very weak solution is required, and after the article is put in the tank, the solution does the rest.

This treatment preserves the edges and details of the design, and makes the surface uniform.

Any of the hard spots not sufficiently affected by the acid bath can be treated separately after the article has been flushed with clear water. Care must be taken that aggregates of the surface are of nearly uniform hardness, or the acid will eat the soft portions out before the harder particles have been cleansed of the cement coating. I have had some very fine work spoiled, when, to obtain a certain effect, I mixed black marble (a limestone) with crushed granite. The acid bath left only the spaces where the black marble had been, while the granite showed a very fine texture and natural color.

As a closing word, while not assuming to instruct the architects present or elsewhere, I wish to advocate the most extensive use of concrete stone made on concrete principles.

The use of crushed marble and granite, with Portland cement as a binder, producing a reconstructed stone of natural components, is not an of concrete, but it gives us a staple building material, combining the beauty imitation of natural stone or a misuse of color and texture of the natural stones with the strength and economy of concrete.

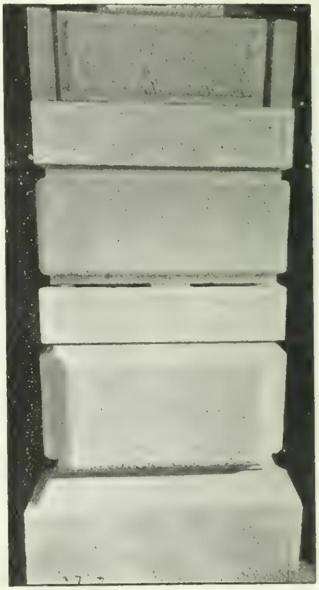

FIG. 6—DETAILS OF SURFACE FINISHES SECURED IN ORNAMENTAL WORK

Winter Work in Products Plants

(FROM CONCRETE PRODUCTS MANUFACTURERS)

BY CHARLES E. SIMS[1]

We have operated our factory through two winters and now have contracts on hand which call for steady running this winter. In the past we have made most of our 12-in. and smaller tile in the cold weather as the demand through the winter and early spring was for these sizes. Last summer we took contracts for several ditches requiring 24-in to 42-in. tile, so that we had to make special provisions for larger curing capacity and in so doing have given attention to the problem of economical heating by making the curing rooms for small tile with low ceilings and with hollow concrete block walls. We thought seriously of making the rooms for these small tile long, low and narrow so that each room would accommodate eight of our cars, 40″x8′ 0″, but finally decided that it was almost as well to have three tracks in one room and the expense was therefore kept down. We have room for 80 cars. Two large rooms with a floor area of 3,000 sq. ft. were floored with concrete for the use of the large sizes.

We cure our products by steam piped from the engine exhaust and also from the boiler when the exhaust is not sufficient of itself, to wells, a number of which are systematically located below the floor line in the various rooms, these wells being made of a single 26-in. tile 30″ long, and covered with a grating. The wells are kept filled with water from the condensation of the steam and from the water that runs off the tile from the spraying given them so that the steam passes through water before escaping into the curing rooms. This method utilizes all steam generated in the plant and creates an atmosphere in the curing rooms that cannot be a drying one. The temperature is kept between 80° and 110° and as nearly uniform as possible. We leave the tile in the rooms in the winter time until satisfied that they are ready to stand shipping when they are taken out and dried before loading. Four days of steaming, night as well as day, are sufficient, and where the tile go into stock it is common practice to cut the time a day short.

We have within the building, storage capacity for several days, run of sand, the purpose being rather to prevent a shortage of supply that to provide for thawing the sand. Hot water is used in the mixer at all times in the winter and as much of it used as possible so that the tile come away from the machine steaming and warm enough to preclude any possibility of frosty materials in them.

Our sand comes from a hillside pit where there is but little water so that we have little difficulty in getting it at any time.

Aside from the subject of frozen materials, I mention that we have almost completed the manufacture of 3,700′ of 42-in. diameter tile for Rock county, Minn., and that these tile go into the ground an average depth of 17′ 9″ and a maximum of 22′ 6″. The earth pressure at the greatest depth is figured at five tons per foot length of tile, hence we made them with 4½-in. wall thickness and reinforced them with electric-welded No. 6 gauge wire hoops, 16 to a tile of 3-ft. length. Half of these hoops are the proper size for placing in the tile ¾″ from the outer surface and the other half the same distance from the inner surface of the tile.

The hoops are wired together in pairs. We have shipped 3,300′ thus far this fall and have had none broken in shipping the 45 miles to Hardwick, Minn.

In manufacturing these tile we used the material as wet as possible; frequently the tile settled an inch or two when the jackets were opened They were made on a National machine[2] the principle of which is a revolving steel plate with an inner and an outer steel jacket setting on it, the material dropping into the jackets from a continuous elevator and being tamped by the machine at the rate of 350 80-lb. blows a minute. It requires some 4,000 blows to make one tile, hence the density of the concrete so tamped was found to be sufficient to make the tile walls practically watertight. These tile are now being laid by Anderson & Co., Vincent, Ia., under the direction of L. A. Wilson, C. E., Sibley, Ia.

The illustrations show the methods of handling the tile. As they weigh 1,900 pounds per tile we had to load them onto cars by use of an incline, a rope around the tile and through a block at the car, and a horse to do the pulling. At Hardwick, they roll two tile at a time onto a wagon and haul them seven miles to the ditch where they are dropped off on end along the ditch.

We have about 150 cars of 30-in. and larger tile to deliver and shall reinforce them all on the same plan though with lighter wire, all for drainage work in this state.

We began shipping this morning (November 21) some 30-in. tile which are part of an order for 60 carloads which go to Madelia, Minn., for a county ditch there.

At every opportunity we have sought to increase the density of our products and to increase the percentage of water mixed in the material. The use of hot water has been one step in this direction. Another has been the regulation of the supply of material to the tile being formed to secure uniformity and another has been the improvement made by the machine manufacturers in the friction holding the tamping bar. On our small tile we have applied the same principle and have increased the packing surfaces on the

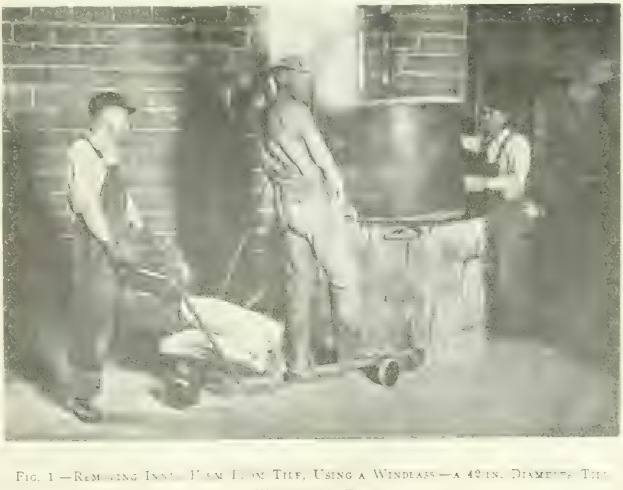

Fig. 1 —Removing Inner Form from Tile, Using a Windlass—a 42 in. Diameter Tile Weighing a Ton

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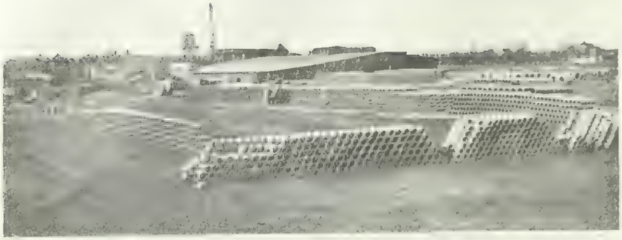
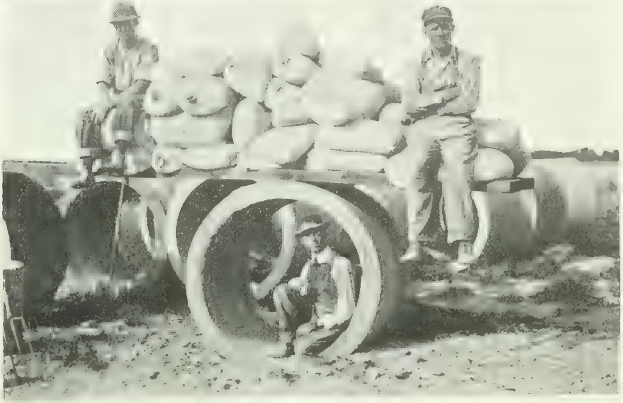
*These suggestions, gathered here in a symposium, do not adhere to one line of thought. They are merely letters and portions of letters from products manufacturers and are published to show that cold weather need not interfere with concrete products work.—The Editors.

[1] Worthington Concrete Tile Co., Worthington, Minn. Attention is called to a letter from Mr. Sims in the Information and Consultation Department, this issue.

[2] Quinn Wire & Iron Works.





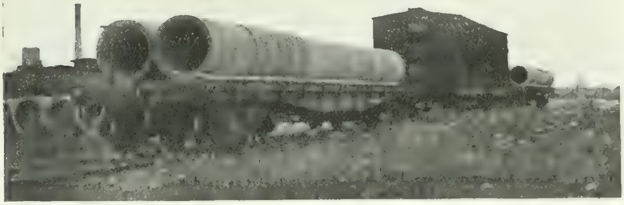


FIG. 2.—WORTHINGTON CONCRETE TILE CO., WORTHINGTON, MINN., SHOWING STORAGE YARD
FIG. 3.—METHOD OF TESTING A 42-IN. TILE; 11,000 LBS. WELL PILED ON 13-DAY OLD TILE
FIG. 4.—TWO CARLOADS OF 50 TILE FOR ROCK COUNTY, MINN., DITCH.—TILE 30" TO 32" BY 34" IN DIAMETER

revolving heads, even though it requires much greater power to operate the machinery.

BY C. STOCKER[3]

As to handling gravel in cold weather, we use the steam curing and we have storage room in our plant for 120 yds. of gravel. We ship in our gravel by rail and have a storage pile of about 300 or 400 yds. outside and near the gravel room. We use steam to thaw out the gravel before moving it into the building. We have a steam pipe extending through the gravel room and out to the gravel pile. In this way we have at all times warm gravel to use. Water for the concrete is used at a temperature of about 95° to 100° F. This is a decided advantage in hastening crystallization of concrete and it permits a much wetter mixture than would be possible were the material cold.

BY JULIUS RUOFF[4]

I generally keep my cement products about four weeks inside before storing in the yard outside.[5] My flower boxes, which I keep outside in winter, I store with the bottom up, so they will not fill up with water, which will afterwards freeze. In the working room the temperature also has to be kept day and night above freezing point, about 50° or 60°.

BY L. HANSEN[6]

For storage of sand for the use through the freezing period, I have found the best satisfaction in having a cellar for the sand and gravel partly under the shop, 10' deep, with one or two shafts outside so the stuff could be dropped from the wagon directly to the cellar and a hoist inside near the mixer, for lifting the sand.

Concrete products without coloring will not be injured as to strength by severe frost when they have attained the age of a day or two. Colored products like roofing tile, etc., must be protected from frost for some time, if the color is not to be affected. The injurious effects in the color are usually only for a time.

BY J. W. MENEFEE[7]

Our concrete block business is not affected by freezing weather except at short intervals when the weather is somewhat below zero. We do not use steam curing, as after exhaustive investigation, we could not see sufficient merit in this system to warrant the expenditure. Instead, we built a shop 100' wide by 150' long, which gives us sufficient storage for 25,000 block. Six salamander stoves fired with coke at a small expense keep the building warm enough for block operations. We have a 50-ft. gravel bank at one end of our shop and storage bins for 200 tons of gravel, which we keep filled when the weather is most favorable. We expect to manufacture for the spring trade close to 200,000 block. These will be made this winter.

BY C. L. FRENCH[8]

In manufacturing concrete burial vaults here we have a steam heated factory, and carry a temperature in it of from 60° to 70°. Our product under these conditions cures so as to be ready to use in 30 days. Our sand we have put into the bin in the fall, and it is protected from the weather. We have no trouble with freezing or caking with our sand in this way.

BY JAMES G. TRESSEL[9]

Freezing weather does not affect our work. I operate a stone quarry with my products plant and store most of my sand for the winter, and if I run short I have a stone pulverizer with which I make sand for winter. I use all limestone dust and stone sand for all concrete work; never used a yard of natural sand in my plant. My plant is 40'x100' aside from kilns. I cure by steam; have a 30 h. p. boiler in center of the plant which makes it pleasant in cold weather. Use steam power for pulverizer, mixer, tile machine, etc. I may be wrong, but I be-

(Continued on Page 45)

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[3] Pingree Grove, Ill.

[4] Philadelphia.

[5] The Ruoff Construction Co.'s work in concrete products consists mainly in the manufacture of flower boxes, Vases and garden ornaments. The products are cured the first day, wrapped in wet burlap and are then submerged in a tank of water.—EDITORS.

[6] Kansas City, Mo.

[7] Menefee Art Stone Co., Fort Wayne, Ind.

[8] Norwalk Vault Co., Norwalk, O.

[9] Ada, O.

Steel Forms for Concrete Construction

I. Uses of Forms on Sewers, Aqueducts and Tunnels are Discussed in Detail

BY WILLIAM MAYO VENABLE

NOTE: This is the first of a series of articles on the use of steel forms for concrete work from the pen of Capt. William Mayo Venable, Mem. Amer. Soc. of Civil Engineers, and engineers of the Building Department of the Blaw Steel Construction Co. Prior to his connection with the steel form industry, Capt. Venable was for many years engaged in the construction of various reinforced concrete engineering works, including a large part of the New Orleans Drainage System, several sections of the Louisville Sewerage System, several sewerage purification refuse disposal plants at United States Army Posts, and the Long Key Viaduct on the Florida East Coast Railroad.

The present article deals with the application of steel forms to conduits, culverts and drains. Future articles will present the status of the steel form in other types of engineering construction, such as retaining walls, grain tanks, reinforced concrete buildings, etc.

The application of forms to wall construction and to the building of columns and floor systems will be given special consideration.—EDITORS]

From the very earliest days of concrete construction until the present, the use of steel for building forms has been constantly increasing in favor. In the earlier days steel was resorted to occasionally by individual contractors who designed and built their own equipment to meet particular conditions, or by builders experimenting to ascertain some more economical method of providing for their centering.

The use of corrugated steel, either plain or galvanized, to support floor loads, both as temporary centering and to be left in place permanently, represented one of the earlier attempts to employ steel for concrete construction. This particular material, corrugated steel sheets, has continued in use for the same purpose, but has found a much wider field of recent years as lagging to support concrete floors of flat slab construction in those cases where the appearance of the corrugations on the ceiling is not considered objectionable. This is probably the most conspicuous instance of an early type of steel center which has come into common use. The low price of corrugated steel and the ease with which it may be placed and moved on work of this kind without appreciable damage makes it the material which appeals to building contractors generally.

The application of steel in the construction of forms for engineering work generally, however, has been brought about largely through the efforts of a few concerns that are specializing in this line. The reasons for this are that the fabrication of steel cannot conveniently be carried on by individual contractors with the facilities which they possess, and that contractors generally are not usually sufficiently familiar with the requirements of steel form designing to be able to design their own forms and have them built for them. Aside from the fact that there are certain fundamental patents on steel forms, there is another reason which likewise has operated to cause the steel form business to be developed as a separate industry, and that is the very great advantage that accrues to the user of the form by being able to lease apparatus suitable for this work, instead of being obliged to pay the full price of having the forms made for his particular job.

Steel forms are in more extensive use in the construction of sewers, drains, conduits, tunnels and such engineering works than in any other kind of construction. Works of this kind possess certain characteristics that are not common to other types of work upon which concrete is extensively employed. They extend for considerable distances without change of section, and they are always, in whole or in part, composed of curved surfaces. A form to construct a sewer or an aqueduct must be designed so that it can be used over and over again very many times. It is not at all uncommon for a form to be used as many as 30 times over in the construction of a single sewer, while in building construction it is unusual for a form to be used over more than 3 or 4 times on one building. Thus, it is readily seen that the form for a conduit should be made much more durable than is necessary for a form which is not expected to be re-used more than a very few times. The use of steel for forms for conduits of all kinds provides a form which is not injured at all by depositing the concrete, but which will retain its shape indefinitely. This, however, is but one advantage of the use of steel on such work. In conduits of all kinds it is necessary to economize space in order that there may be room for the workmen inside of the conduit and also room for shifting the forms themselves. Wooden centers, in order to secure the necessary strength, occupy so much room with their bracing and other frame-work that it is very nearly impossible to arrange to shift them with the necessary degree of economy.

In conduit work there are two different methods by which the work may be carried on so far as the forms are concerned. Forms for one section may be set up, concrete deposited about them, and the forms then removed and carried forward for another section, the process being repeated thus until the entire structure is finished. If the work is carried on in this way it is not necessary to pull one set of forms through the conduit which is occupied by another set. The other method of conducting the work is to provide forms for a given length of conduit and constantly to convey the forms from the portion of the conduit which is completed through the portion of the conduit which is being constructed, and to set them up in front, where the conduit is to be extended. It may readily be seen that with wooden forms the first of these methods implies taking the forms apart into many pieces, carrying these out of the ditch and assembling them again in a new position; while the second method implies taking the wooden forms apart in panels and conveying these panels forward through the bracing which supports the panels upon which the concrete is being placed. These are both extremely laborious and expensive processes with wood. With the use of steel forms they are rendered extremely easy.

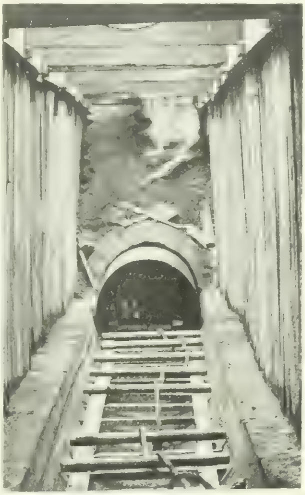


Fig. 1—Sewer Construction in a Deep Arch Using 45-in. Half Round Steel Form

In this view the invert has been completed, and the cover is being run

On conduits of moderate size, where the depth of the excavation is not very great, it is usually found more economical to shift the forms from one position to another without conveying them through forms already set up. Steel forms when used in this way are provided with a carrier of some kind, usually a series of small wheels attached to the sides of the form, by which they may be conveyed forward without being taken apart at all. Thus 100′, or even 200′ of centering for a sewer may be moved at one time, it merely being loosened from the concrete by means of turnbuckles, lowered upon wheels and pulled out with a line to the new position in which it is raised to the proper height and braced to the proper width. This is called pulling the forms "en train."

To give a fair idea of the use of steel forms on conduits constructed in this way, a number of illustrations are here shown. It will be observed that where a section is circular the same form may be used to form the invert as is subsequently used to form the arch, but usually the form for the invert is kept separate from that for the arch, the invert being built first and the arch built subsequently. In circular conduits a center for either invert or arch consists of plates bent to a little more than half a circle, stiffened by angle-irons running longitudinally, joined together at intervals by simple fasteners so as to form a continuous trough, and placed in such a position that it may be collapsed or stiffened, if necessary, by means of turnbuckles.

A circular section is by no means adopted for most of the larger sewers or drains. In some of these structures the bottom, or invert, is made with sides having only sufficient inclination to keep them free from deposit when the conduit is in use. The side walls are often perpendicular for some little distance, and the arch semi-circular. This form of conduit can be built in three operations, viz., the invert, the side walls, and the arch; or may be built in two operations, consisting of invert and portion of side walls, and the balance of the side walls and the arch together. Modifications of this design are very common, in some cases the side walls being slightly curved. Egg-shaped and flattened elliptical conduits are often required, and these, as well as the circular, lend themselves to the use of steel in their construction. It is, of course, obvious, however, that the circular and semi-circular sections, being in such common demand, can usually be constructed much more cheaply than other sections, because forms for them can be used on many different contracts in succession throughout the country. Engineers are generally well aware of this fact, and take advantage of it in making their designs. There is scarcely an important sewer system which has been contructed in this country in recent years upon which the half-round collapsible center has not been used to a considerable extent.

Generally speaking, it is more economical for the contractor to build a sewer in two sections, the invert first and the arch subsequently, no matter what the cross-section of the sewer may be, than it is for him to pour the entire structure in one operation. It is also generally preferred by engineers that the invert shall be constructed and the forms removed for inspection before any work is done on the arch, and where sewers are reinforced with steel, the splice of the steel is generally made above the springing line of the invert. By dividing the work in this way the engineer is able to inspect the most important part of it, the invert, which carries the actual flow of water, without having to enter the finished conduit. It is also often preferred that the men should work in daylight rather than by artificial light to do any work requiring close inspection. There are, however, numerous occasions upon which it is considered essential that the structure shall be poured as a monolith, and in such cases it is necessary to build the form so as to make a complete circle, which may still be collapsed and removed conveniently, care being taken that the joints are so made that one or the other of the sections may be removed first. If the design is not very carefully worked out with this object in view, a full round center is likely to bind, and become extremely difficult to shift. One of the illustrations shows the full round center composed of ten sections, each 5′ long, connected together in the same manner as it would be connected if placed in the ditch.

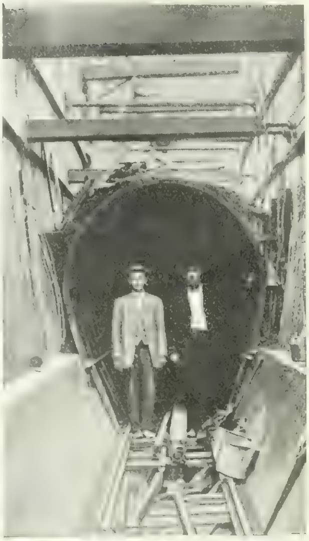


Fig. 2—Egg-Shaped Sewer Construction With Steel Forms

The completed invert, with the reinforcement laid back against the side walls, is shown in the foreground

Half-round centers to be pulled "en train" have been made and used of all diameters, from 2′ up to 25′. Usually, however, the length of time that a center must be left in place on a conduit of the larger size, and the necessity of arranging the work so that the concrete can be deposited every day, render it necessary on large work to design the centers so that they may be collapsed and pulled through one another. Just when it will be more economical to pull a center "en train," and when it will be more economical to collapse it and carry it forward in sec-

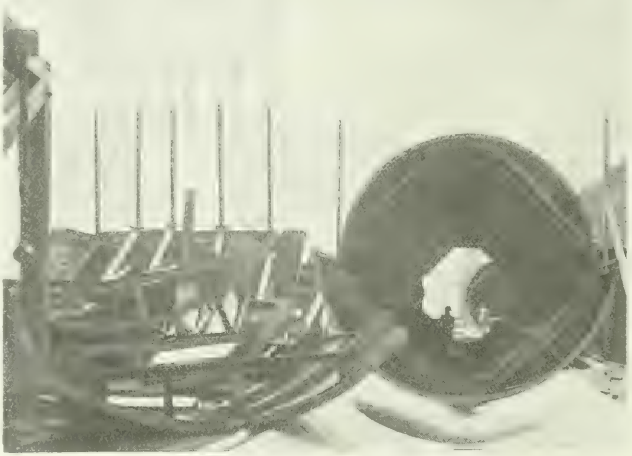


Fig. 3—Steel Forms for Lock Flumes at Panama

tions ought to be determined in connection with each particular construction after careful consideration of the local conditions, the depth of the excavation, the arrangements for depositing concrete and the liability of the work to interruption or injury on account of having a greater or less amount of open ditch at one time. Wherever it is practicable to stretch out the work over a long distance without incurring any liability to damage, there will be a certain advantage in arranging the work in several sections and pulling the forms "en train," rather than in collapsing them and carrying them through one another; but on the largest work it is very seldom practicable to spread the work out in this way, and usually where the conduit is more than 8′ or 10′ in diameter more economy will be secured by building the center in sections and collapsing one or two or three sections at a time and conveying them forward through the assembled sections of form to the new position.

On the large concrete sewers, aqueducts and drains built in recent years, it has been almost universal with contractors to collapse the centers sufficiently to convey them through other centers which are supporting concrete which has not yet set sufficiently to permit the centers to be moved. The best example of this method of working is found on the new Catskill aqueduct which supplies the city of New York with water. This aqueduct is 90 miles long. Throughout most of this length water is conveyed in a horseshoe conduit 17′ 6″ wide and 17′ high, built at a grade which permits the water to flow without completely filling the aqueduct. Other parts of the work are in tunnel, or on viaducts; while that portion of the work which enters the city of New York is in many places at a great depth from the surface of the ground. Practically all of this concrete has been cast on steel forms.

Where the work is conducted in open cut, these forms are collapsed and supported upon carriers in the finished aqueduct, and they are conveyed through the portion of the work which is yet under construction and expanded into position in front. The same method of

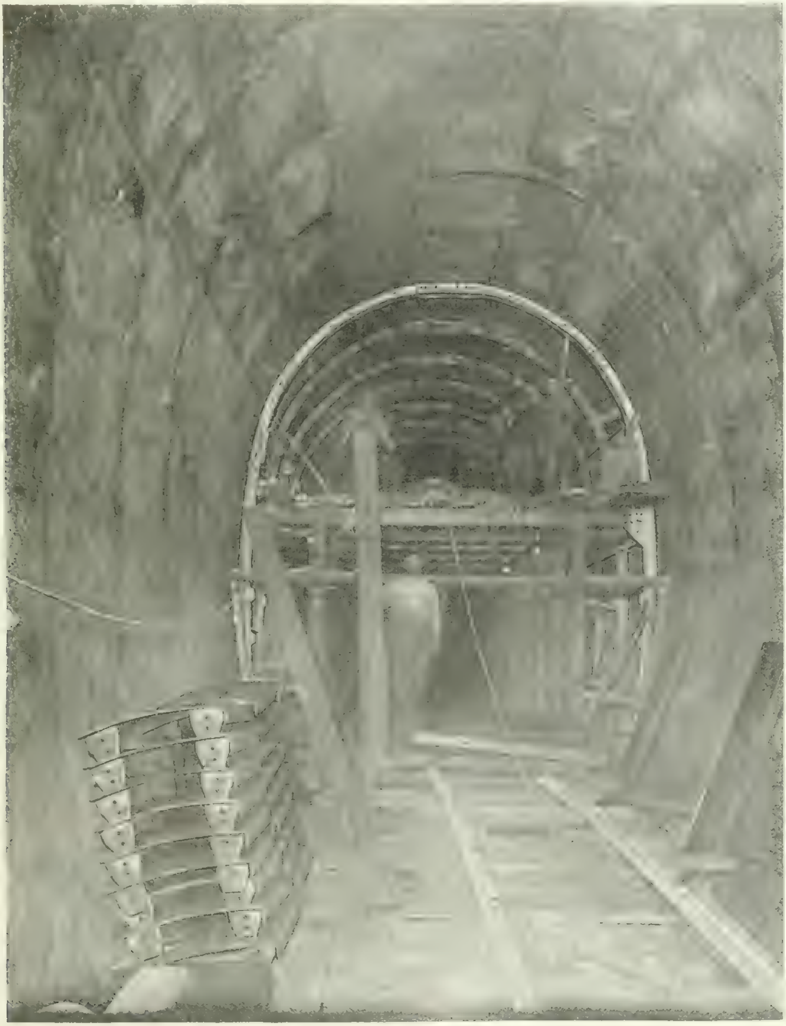


FIG 4—STEEL FORMS ON THE CATSKILL AQUEDUCT WORK

handling the forms has been employed on the new sewerage systems at Louisville, Baltimore and East St. Louis.

Very large forms adapted to collapse and move forward in large units have been used on the locks of the Panama Canal and for the pressure tunnel of the Ontario Power Co.

In tunnel work, it is sometimes possible to utilize forms that collapse and pull through in units similar to those used in sewer work, but very frequently on account of the difficulty of getting concrete into place in tunnel work, it is necessary to carry on this work with a series of panels which are attached to ribs as the concrete is deposited. This method is extensively employed in tunnel work for railways and while not nearly so easy to handle as the form that can be moved in large units, it has proved to be eminently practical and economical in work of this class.

In all such work it is customary to build the forms especially to fit the design of the particular structure in view, and not to attempt to consider the form problem at all in the design of the concrete structure. Wherever the length of the conduit is sufficient, this is the most economical practice, but where the lengths of the conduit is not great it will be found more economical to use circular or modified circular forms upon which a standard steel form can be used,—a form which can be leased for the moderate rental—than to adopt a peculiar shape which will require a form built to order, and consequently an unnecessarily heavy expenditure for the form work. It should be remembered that where forms are made of wood to meet any particular conditions, they cost 12c to 16c per sq. ft. of form surface, and that if the walls of the concrete structure be thin, this amounts to over $5.00 to $10.00 per cu. yd. of concrete in place. In fact, the cost of forms on very many concrete structures exceeds the sum of all other costs entering into the concrete. The saving that may be made by adopting sections which will lower the cost of the forms is so great that every engineer should consider it in making his designs, more especially upon those parts of the system he is designing which are too short to justify the manufacture of special apparatus for constructing them.

The cost of a system of concrete storm sewers may very easily be reduced by 15% or 20% of what it might otherwise be by having careful consideration given to the cost of the form work, and so laying out the system before construction is commenced as to secure the greatest economy in this item.

All collapsing and conveying methods used on forms similar to those described for circular and horse-shoe shaped conduits are adapted to rectangular or box-shaped culverts such as are commonly employed in flat lands where it is necessary to build drains of large capacity without deep excavation. Box-shaped forms for drains with flat slab covers should be designed so that the same forms can be used on the various sizes of drains in any common drainage system, beginning with the largest on the main line of the system and extending to the smallest laterals. Forms of this kind are readily made in such a manner as to permit the removal of panels of various width so as to change the width and height of the conduit wherever necessary.

It is impracticable to describe the enormous variety of uses of steel forms applied to tunnels, aqueducts, sewers, drains, mine shafts, etc., in a single article because the types of such structures are almost as numerous as the number of structures; but there are very few conduits which can not be centered more economically in steel than in wood, the determining factor usually being the amount of conduit of the given section to be built. Generally speaking, it is necessary to have work so laid out that the form may be used a number of times, in order that the saving in handling the steel form may exceed the additional cost of the steel form over wooden forms to do the same work. If the conditions of the work are such that a form can be used once only, it will almost always be found more economical to build the form in place and to make it of wood. The only exception to this will be found in these few cases—where the conditions under which the concrete is to be deposited and the stresses imposed upon the form are very unusual. There are many cases where the steel form will prove more economical, especially where it can be obtained on lease basis, where there is opportunity to use the same form over a half dozen times or so only; but when there is a chance to use the form 10 to 15 times over, there will be found few cases where the steel form will not be found more economical than any wooden form; and in every case where properly handled the well designed steel form may be relied upon to secure the very highest character of construction work.

To avoid any confusion, in referring to pages in this issue of Concrete-Cement Age *and to later numbers when they shall have been gathered together in a volume, the attention of the reader is here especially called to the new system of numbering pages inaugurated in this issue of the magazine. Advertising pages will have separate page numbers in a new series each month, beginning with 1. Editorial pages will carry one series of numbers through an entire volume of six issues. In this issue and again next month there will be two pages bearing like numbers, except that a difference will be noticed in the style of type used, a black face type being employed on advertising pages.*

Sculptured Concrete Products Made at Minnesota Plant

Some work in concrete products manufacture, quite a little out of the ordinary, has been done at the plant of the Owatonna Concrete Tile Co., Owatonna, Minn. In the two pieces, reproduced in the accompanying illustrations, granite has been used as an aggregate, and after the work was entirely hard, it was gone over by a stone cutter exactly as is done in sculpturing stone, with the result which is shown in the pictures. Concrete gravestones and monuments also have been constructed at this plant and granite effects have been reproduced with remarkable fidelity.

Marketing Mine Tailings for Concrete

BY F. M. CLUTTER

Of the making of good Portland cement there is no end. Engineers and experienced concrete workers have perfected appliances and machinery for all manner of concrete work and the testing of cements. But to Dame Nature alone must we look for the aggregate which goes to make up the main body of the finished product. While some authorities differ in regard to various minor qualifications they all agree that the ideal aggregate is one that is hard in nature, angular in shape, varied in size and clean.

Fortunate indeed is that locality that is blessed with an abundant supply of good, clean bank gravel or river gravel. Other localities not having either of these but having outcropping stone have installed crushers for producing the materials of the various sizes required. Unfortunately some of these ledges are composed of a soft limestone that on exposure to the air begins to disintegrate; this kind of stone cannot produce a reliable quality of concrete.

Southwest Missouri and southeast Kansas, what is known as the zinc and lead district, are blessed as are few districts, with an unlimited supply of what could be truly called an ideal aggregate, for here piled on the ground are millions of yards of mine screenings from the zinc and lead mines, and thousands of tons are being produced daily. Through the courtesy of S. A. Jones, of the American Gravel Co., I witnessed the production and loading of this material.

The lead and zinc are found disseminated through a formation of hard blue flint. This is mined at a depth of 150′ to 200′, hoisted to the surface, crushed to ½″ or ¾″ in size and run through concentrating plants. This process forms hard, sharp particles of all sizes from ¾″ to the finest sand. The mineral is concentrated by running this crushed flint through "jigs," where it is kept constantly in motion in water; here the ore, being heavier, settles to the bottom and is drawn off through valves, while the refuse or "screenings" is taken from the jigs, mixed with fresh water and wasted by piling up near the mills. On one of the tracts of ground held by the American Gravel Co., operated by the American Zinc, Lead & Smelting Co., there are piled up more than 4,000,000 cu. yds. of this material and it is being produced at the rate of 4,000 tons every 24 hours by the mills on this 80-acre tract. The holdings of the Independent Gravel Co. are equally as extensive, though more widely scattered.

For years this refuse was piled up and was a detriment to the ground, there being no known use for it. The railroads first began to use it for ballast, and soon extended its use to their concrete work where it was found to meet the requirements of an ideal aggregate. Consisting of nearly pure flint, it is as hard an aggregate as can be obtained. In crushing it breaks into cubical or angular fragments thus producing the sharp corners that are necessary for a perfect bond. In commenting on this material, Robert W. Hunt & Co. say:

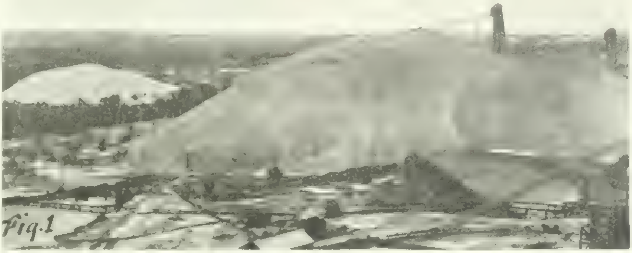
> The chemical analysis shows flint unquestionably of greater strength than any lime rock with which we are familiar, and as such insures greater strength as a component of the aggregate, than any mortar probably can ever develop.

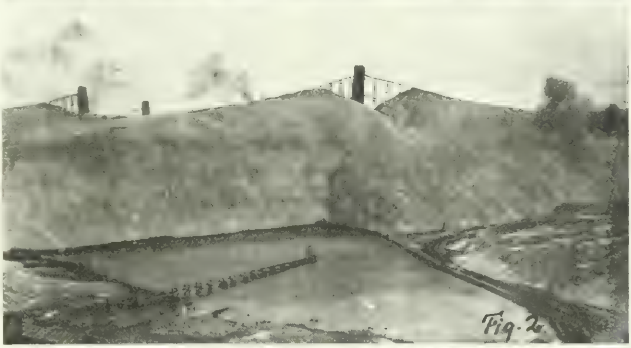
This is valuable inasmuch as many failures in compression are due to the failure of the rock rather than the cement mortar.

The sizing of the material is well adapted to filling the voids of the relative larger sizes of the aggregate and should show as dense a mix as could be obtained by very careful grading of sand, gravel and stone.

Combining as it does proper proportions of sand-like particles and stone, the only requirements for the production of as good a grade of concrete as can be obtained, is care in mixing.

As the use of this refuse product was extended by the railroads a demand gradually developed for it in a commercial way among those who saw it in use on the railways. Today the business has increased until all the available piles and producing mills are under





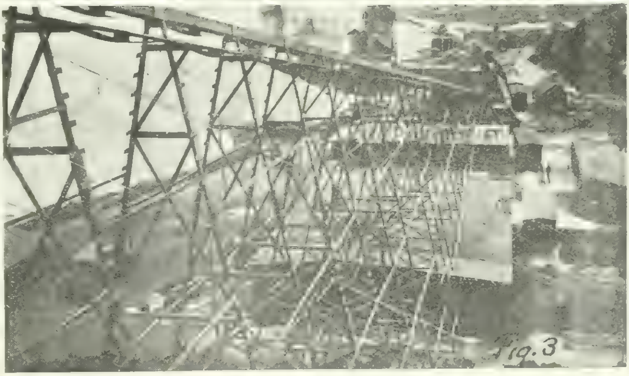


FIG. 1—SCENE AT AMERICAN GRAVEL CO. MILL NO. 1
FIG. 2—HERE ARE [illegible] YARDS OF CONCRETE AGGREGATE
FIG. 3—FLUME [illegible] MILL NO. 3, CAPACITY [illegible] TONS DAILY

lease, and hundreds of cars are shipped by the three largest companies in the district who have their offices in Webb City, Mo., and ship from all over the district. Hundreds of lumber yards are carrying this in stock the same as they do sand, and are experiencing steadily increasing demand for it.

The loading companies have spent thousands of dollars experimenting with loading devices and have now perfected an electric device which enables them to handle 200 tons per hour thus placing them in position to supply all demands. To meet the demand for a screened material for use where exact proportions are required, a screening plant was installed and the fines removed.

One feature of growing importance is the shipping of what is called "jig sand," consisting of the fines taken from the jigs. Each and every particle of this is hard, sharp and clean and possesses the advantage of being of a uniform quality, having been washed and screened.

A dividing wall recently collapsed in a six-story Brooklyn tenement, reports a writer in the A. A. P. C. M. *Record*. Local papers headed the article the usual way, namely: "Cement Wall Collapsed." The customary thrilling details followed. When the inspector got on the job he reported in part as follows:

"A four-inch terra cotta partition wall about seven feet six inches in height dividing the cellar wall was pushed down by the pressure of a few tons of coal. This wall does not affect the structural part of the building."

Cement manufacturers and salesmen says the A. A. P. C. M. *Record*, are sometimes embarrassed by having presented to them convincing evidence that concrete for certain purposes has partially or totally failed. Such occasions are rare, but concrete is not impervious to everything under the sun, and now and then it encounters a destructive force or agency. But there is always opportunity to ask the critic of concrete a pertinent question, namely, "do you know of anything that will answer the purpose *better* than concrete?" In nearly all discussion as to the effect of certain substances upon concrete, the talk begins and ends with concrete. This is a compliment to the sincerity and honesty of the concrete man, for he is careful not to recommend cement for purposes to which it is unsuited. Hence it does not always occur to him that even though concrete may not withstand prolonged attack under specific conditions, it may, after all, be better than any other material and should, therefore, be used. For example, there are the problem of electrolysis, the action of alkali and kindred questions. Will any other available material subject to the same stress behave as well as concrete?

The most absurd of all the attacks upon concrete is that made by advocates of clay substances, whose integrity depends absolutely upon the cement mortar which binds the units together.

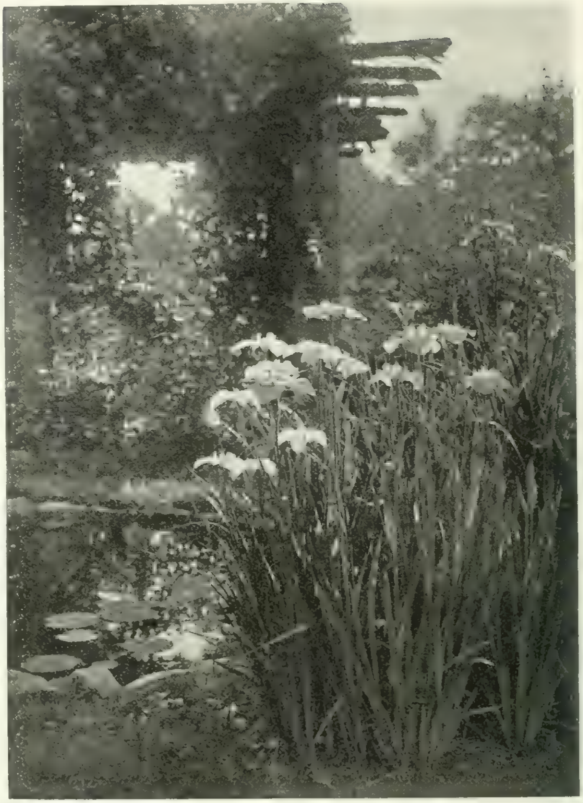


Fig. 1—Concrete Pergola in Beverly, N. J., Garden of J. Fletcher Street, Architect

Concrete with Relation to Its Environment

BY E. A. TREGO

One of the most satisfactory things about concrete is that, given proper environment, there is no occasion to go beyond extremely simple forms. This means economy without the sacrifice of beauty. Where concrete is to be partly covered or surrounded with flowers, vines and shrubbery, its structural design may be as direct and unpretentious as it is possible to make it, whereupon it takes its place as naturally as the trunk of a tree or an outcropping boulder. This is illustrated in the accompanying pictures of a garden in Beverly, N. J., at the home of J. Fletcher Street, architect. The garden was designed by Mr. Street, and much of the work involved in its development was done with his own hands. The pergola was selected as an illustration of the point to be emphasized. These octagon-shaped columns are, of course, of cinder concrete, surmounted by poles of red cedar. The pergola, which is 8'x12', has four columns. They are 2' square at the base and 18" square at the top. Each has a foundation in the form of a concrete cube 2' 6" each way. A square board form was erected, and corner pieces inserted to form the octagon. A finishing coat was included in the original plan, but the columns looked so well in their crude state that it was never applied, and never will be so long as Mr. Street controls the situation. As stated above, the undressed cedar timbers and the simple gray columns seem a natural rather than an artificial feature of the garden.

To make these columns required 3 bbls. of cement and 3 cu. yds. of cinders, the work representing 4 days' labor for one man. The cedar poles cost $18, and the cost of the concrete may be approximately estimated from the quantities given. To have procured the conventional sort of arbor, with elaborately designed columns and dressed timbers, would certainly have cost over $100.

The interesting pictures published show what sort of environment lends itself to concrete construction of this character, and when developed with appreciation and understanding it becomes as satisfactory as the most ornate and

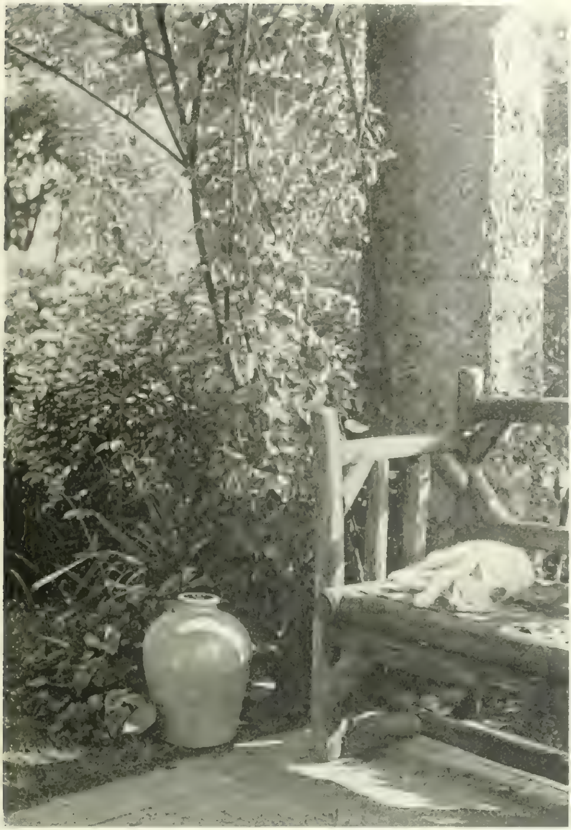


Fig. 2—Close View of a Single Column Showing Coarse Texture of Cinder Concrete

costly type of construction, if not more pleasing. Fig. 1 shows a column with the cedar poles projecting beyond the vines. Fig. 2 shows in greater detail the rough surface of the column and the adaptability of cinder concrete to this and kindred purposes.

Fig. 3 is a garden bench decorated with Moravian tiles. The ends or supports of the bench were made in a metal mold, but the slab was cast on the ground with 2x4's for a mold. The tiles were pushed into the wet concrete, and are firmly embedded; a much easier process than to leave depressions in which tiles must be subsequently placed and pointed.

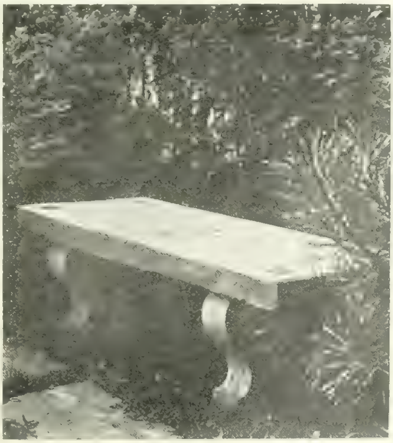


Fig. 3—Garden Bench; Slab was Cast on the Ground, 2 x 4's for a Mold

Good Roads and the Cost of Living.*

BY W. W. FINLEY.†

A subject that is being almost universally discussed in other lands as well as in the United States is the high cost of living. In the periodical literature of the day it occupies a prominent place and many are the influences to which it is attributed. Whatever may be other contributory causes, I believe that statistics establish the fact that population and demand for the materials for food and clothing are increasing at a greater rate than their production. Most of these materials are produced on the farm and we must rely upon the farmers to bring their production up to the prevailing demand. In my opinion, the two factors that will be most potent in bringing about this result will be increased average yields per acre of farm crops and the placing of increased areas of land under more intensive cultivation.

As to the first of these, I shall say nothing more on this occasion than that modern scientific farming is demonstrating the practicability of greatly increasing soil productivity and that, in the Southeastern States at least, substantial progress is being made in the practical application of the methods necessary to bring about increased average yields per acre and for the larger production of meats and dairy products. For the extension of these improved methods of farming over larger areas we must rely very largely upon the improvement of the country highways. Some idea of what may be accomplished in this direction is given by the figures of the last census which show that, in the nine states south of the Ohio and the Potomac river and east of the Mississippi river which are traversed by the Southern Railway system and which have a superficial area of 264,058,880 acres, only 82,831,384 acres were classed as improved farm lands.

Everyone who has had any experience in the matter knows that among the first things a prospective farm settler wants to know about is the distance from the railway station and the character of the road from the station to the farm that is being offered to him. Some branches of agriculture are much more dependent upon good country highways than others. The man who is engaged exclusively in the raising of cattle which can be driven for long distances to a shipping station, as is still done to some extent on Western ranches, is, in a measure, independent of the condition of the roads. The grower of corn and any other crops which can be stored for a time without deterioration, can manage to get along even though his road to a shipping station may be impassable at times. He is greatly hampered, however, by the necessity of doing his hauling in good weather, regardless of market conditions and of whether or not his farm operations may be seriously retarded by the absence of himself and his team. For the dairy farmer, the fruit and vegetable grower, and for the producer of perishable commodities of all kinds, ability to get products to market at all seasons of the year and in all kinds of weather is absolutely indispensable to success. For all kinds of general farming, therefore, a good country highway is essential to the most profitable operation of the farm and to any considerable development of agriculture at a distance from a market town or shipping station.

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†President Southern Railway Co.

*Abstract of address made at American Road Congress, Atlantic City, N. J.

This whole subject of the effect of good roads upon farm production and the cost of living is one which concerns all classes of people. Primarily and most directly, the benefits of good country highways go to the farmer. Less directly, the benefits go to merchants and manufacturers by giving them wider markets for their goods and decreasing the cost of distribution.

From the viewpoint of the railway, to the extent to which the good road extends the area of profitable agriculture, leads to increased production, and adds to the prosperity of the farmer, it enlarges the volume of traffic. It is for this sound business reason that many of the railway managers of the United States are manifesting a practical and helpful interest in the good roads movement.

Increasing farm production by getting more people onto the land and by bringing enlarged areas under more intensive cultivation is largely a matter of transportation. If the farm is to be profitable, its products must be sent to market. Wherever the final market may be, the first movement is over the country highway, which thus becomes a part of the general transportation system, including waterways and railways. In some localities railway construction may be necessary to the provision of adequate facilities for carrying farm products to market. But in the many localities adjacent to existing railways which are capable of higher agricultural development, the necessity is for the improvement of the country roads.

Present Roads or Future Railways?

May it not be a fact that the transportation needs of many localities that seem to be waiting on railway construction would be met more satisfactorily and more comprehensively by a system of good roads connecting them with existing railways? The railway should be located with reference to the main traffic channels. It can no more take the place of the wagon road for the collection and distribution of traffic in a rural community than the wagon road can replace it as a main highway of commerce. Considered as parts of a general transportation system the railway and the wagon road supplement each other.

The Use of Concrete in Porch Construction

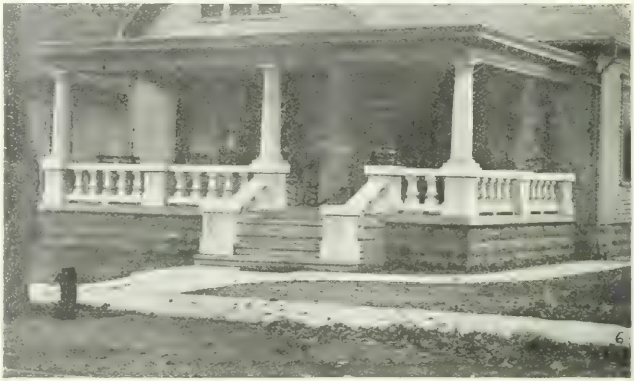

Fig. 1—Porch Built of White Concrete Products

An Attractive Porch Built of White Concrete Products

The porch shown (Fig. 1) is the work of the Bennett-Barnes Co., Terre Haute, Ind. The concrete is made with white cement, white sand and white marble. Columns, capital, and column base are from the Architectural molds.* The pedestal base, pedestal cap and end rail were made from adjustable steel molds of the Bennett-Barnes Co.'s own make. Porch steps also were factory made and laid up, as shown.

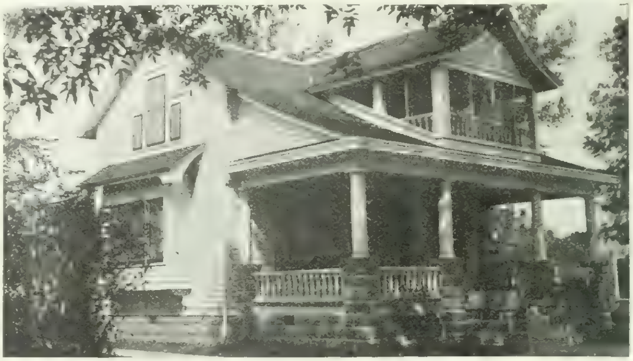

Fig. 2—A Concrete Porch Which Cost $400

Some Cost Items For An All-Concrete Porch

The attractive concrete porch shown in the accompanying illustration (Fig. 2) cost about $400. It was built by C. A. Simons & Son, Fort Scott, Ark. The columns cost $14, set up; reinforced concrete floor, 25c per sq. ft.; steps. $1.00 per cu. ft. The block in the foundation cost the porch owner 30c each, laid up—the builders paying 5c each to have them laid The flower boxes, made in Simpson* molds of a 1:3 mix. are 3′ 4″ long, sell for $5.00 each. They are made in various lengths 2′ 5″ to 3′ 6″. Triangular mesh reinforcing† was used.

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*Architectural Mold Co.

*Simpson Cement Mold Co.
†American Steel & Wire Co.

Information and Consultation

The Questions and Discussions in this Department are of interest and real value. Speaking of our questioners, we earnestly ask readers to discuss the questions submitted. For men in field and office, let this be a real consultation section, an exchange of ideas, among those who have, and those who have not, solved some of the problems of structural concrete. Questions and Discussions are cordially invited.

144. The Drying-Out of New Buildings

"How long should a 4-story school house, structural concrete floors and interior walls, slate roof, and common brick exterior walls, dry out before placing the maple floors?"

144. Discussion by K. H. Pratt*

It seems to me that in the summer time two or three weeks on each floor should be sufficient to dry out the floors so that there will be no difficulty in laying the maple flooring after the floor strips are bedded.

We believe the only safe way to lay flooring on top of floor strips where there is a question as to the building not being dried out, would be to use a tarred paper over the strips and cinder fill. We have found that this has worked very satisfactorily in the past.

144. Discussion by Jno. T. Simpson†

Our experience has been that maple floors can be laid in concrete school buildings in from 30 to 60 days after pouring the concrete, depending on the state of the weather. We have found, however, that unless heat is put into the building and kept going continuously, maple floors will buckle, even if laid 3 or 4 months after the concrete work has been installed. This is somewhat due to the fact that the sleepers and the cinder fill between them are usually laid quite a while after the reinforced concrete has been put in place.

* * *

168. Storage of Cement in Winter

"I would like some information in regard to storage of cement in store houses over winter in the cold states, such as Maine. This information will be of great value to me, as my company is planning to store 12,000 bbls. for the winter to use in summer."

168. Discussion by C. W. Boynton‡

Regarding the storage of 12,000 bbls. of cement through the winter, we believe that, in the majority of cases, the housing of such a large quantity of cement throughout the winter is not to be advised, unless it is impossible to get the cement fast enough to the job when desired. The case, of course, sometimes arises of isolated districts where, in order that the work may progress rapidly, the cement must be hauled to the job a long time before its consumption, in which case some provision would have to be made for taking care of it.

The precautions which must be taken in storing cement through the winter months are no different from those to be recommended in summer. The aging of cement has no effect upon its strength providing there is no hydration of the particles. Hydration can come only through the introduction of moisture and since the humidity of the atmosphere is no greater in winter than in summer, the problem resolves itself into one of keeping the cement away from dampness by piling the sacks within a tight, weather-proof building, at least 8″ away from the ground and an equal distance from any wall, so that free circulation of air may be obtained. In case the floor of the warehouse is laid directly above the ground, it would be well to give the cement an additional 8″ elevation by means of a false floor, so as to insure ventilation underneath.

Where cement is stored in high piles for long periods, there is often a slight tendency in the lower layers to harden, caused by the pressure above; this is known as "warehouse set." Cement in this condition is in every way fit for service and can be re-conditioned by letting each sack drop on a solid surface before using the cement contained—often possible with little labor by dropping each sack from the pile on to the surrounding floor just before loading out. The need for work of this kind, however, can generally be eliminated by keeping down the height to which the sacks are piled—probably not over six or seven layers, which not only has the advantage of preventing "warehouse set," but makes the handling much more economical.

168. Discussion by M. C. Tuttle*

The storage of cement in winter is precisely the same problem as the storage of cement at any other season of the year, so far as I know. It is simply a question of a tight shed and piling the cement in such a way that the different shipments can be recognized and that the cement is accessible for use. In the construction of the Aziscohos (Maine) dam, large quantities of cement, steel and other materials were teamed in in the winter months with little trouble, for use in the summer.

168. Discussion by W. E. Wagner*

The storage of cement over winter is much more easily accomplished in northern climates than in localities where the weather is milder. I do not think the cold is at all injurious to cement. The danger lies in the mild, damp days that are apt to occur even in northern Canada.

In the construction of the Trent Valley canal, cement is taken in on the snow in quantities of 10,000 bbls. and stored in sheds without heat. I have not heard of any injury to the cement from this.

* * *

239. The Storage of Explosives

"What is the comparative value of concrete and other masonry structures for use in constructing storehouses for explosives?"

239. Discussion.

[The following notes are abstracted from Technical Paper 18 of the Bureau of Mines, "Magazines and Thaw Houses for Explosives," by Clarence Hall and Spencer B. Howell. The question was previously discussed in *Cement Age*, for March and April, 1912, pages 148 and 202 respectively. It is generally recognized that while magazines must be built with sufficient solidity to be reasonably permanent, weatherproof, burglar-proof, and in hunting districts, bullet-proof, a material must be used which in case of explosion will shatter easily and into fine fragments. Otherwise large pieces of masonry may be hurled several hundred yards and do considerable damage.

In work mentioned in the above references, very heavy concrete walls were used with a light timber roof. In case of an explosion, the explosive force was directed upward with very little damage.—Editors.]

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*Bolton-Pratt Co., Construction Engineers, Cleveland.

†Cons. Eng., Newark, N. J.

‡Eng. in charge Information Bureau Universal Portland Cement Co., Chicago.

*Secretary, Aberthaw Construction Co., Boston.

*Contracting Eng., Toronto, Can.

The application of explosives to the arts of peace has received a tremendous impetus in recent years, and today by far the largest proportion of the explosives manufactured in this country is used in engineering and mining work. In order that the demands of the users of explosives may be promptly supplied, it is necessary that manufacturers, transporters, distributers, and users of explosives maintain proper and adequate storage facilities. The necessity therefore arises of having magazines in which may be stored large quantities of explosives. At high temperatures explosives may become unstable and more sensitive to shock or frictional impact; consequently they should be stored in cool places. As the addition of moisture is deleterious to all explosives, it is undesirable to store any explosive in a damp place. Hence, in order that correct conditions may prevail, explosives should be stored in a thoroughly ventilated magazine situated on well-drained ground.

The construction of magazines differs materially, many of them being substantial structures built of concrete, brick, or large blocks of stone. These materials are objectionable in the event of an explosion within a magazine. More frequently magazines are built of a light framework of wood covered with corrugated iron, and no attempt is made to protect the explosives against the penetration of rifle bullets.

The first investigation undertaken by the Bureau of Mines aimed to find a suitable material that could be used economically and that would be effective in resisting the penetration of rifle bullets.

Disintegration Tests on Cement Mortar Blocks.—Because of the danger arising from the use of concrete or solid masonry for the construction of magazines, tests were conducted to find a material that would shatter easily and at the same time produce a building sufficiently substantial to meet all requirements. Following is a description of the procedure and the results of the tests:

Sixteen ⅞" by 8" cartridges of 40% nitroglycerin dynamite, having an average weight of 111 grams, were placed as in the sketch on a 24" by 24" by 6" block of cement mortar, made of 1 part cement and 6 parts of coarse sand, the mortar being 75 days old. The block was placed in a horizontal position and supported by 2 2-in. pieces of gas pipe. Four No. 6 electric detonators connected in series were used to detonate the change and were placed as indicated by the small circles in the sketch. The paper ends of the cartridges were cut off before they were placed on the block.

The pieces resulting from the explosion were screened, with the results shown in the accompanying table. The dimensions of the screens represent the inside dimensions of their square opening. The material passing through the ¼-in. screen was thoroughly disintegrated to sand and cement dust.

Screening Test of Disintegrated Cement-Mortar Block.

Size of material.	Lbs.	Per cent.
Caught on 1¼-in. screen....	5⅛	2
Caught on ¾-in. screen, through 1¼-in. screen.....	4	2
Caught on ¼-in. screen, through ¾-in. screen......	12¾	6
Through ¼-in. screen.......	205	90
	226⅞	100

The results of the test clearly indicate that in the event of an explosion in or near a magazine constructed of cement mortar, the mortar would not be projected in large masses over the surrounding country. On the other hand there is a record of an explosion of the explosives stored in a concrete building having six compartments; in that explosion blocks of concrete weighing as much as 1,000 lbs. were projected 700 or 800 yds.

Bureau of Mines Magazine

As a result of experiments and of information furnished by the manufacturers of explosives, a cement-mortar magazine has been erected by the Bureau of Mines. The magazine has a capacity of 20,000 to 30,000 lbs. of explosives, and was built at a cost of $400. The outside dimensions are 10' by 14'.

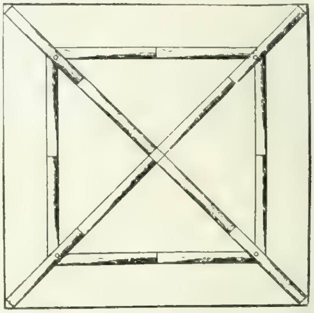

Fig. 1—Arrangement of Cartridges on Cement-Mortar Block

The salient features of the magazine are the cement-mortar walls, sliding door, and roof. The cement mortar is

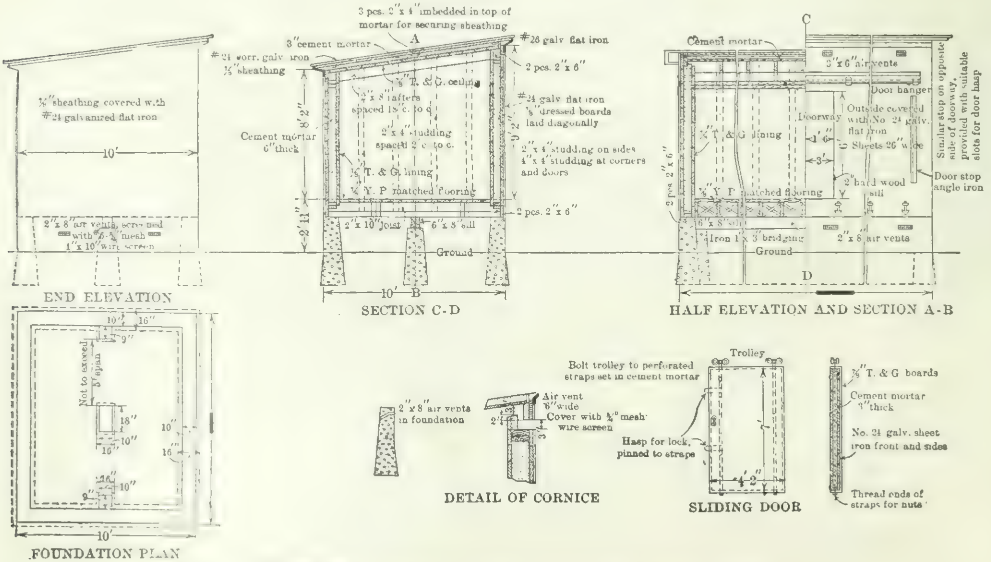
⅛" sheathing covered with #24 galvanized flat iron
10'
2"x8" air vents, screened with #6-¾" mesh 1"x10" wire screen
END ELEVATION
3 pcs. 2"x4" imbedded in top of mortar for securing sheathing
3" cement mortar
A
#26 galv flat iron
#24 corr. galv iron
⅞" sheathing
2 pcs. 2"x6"
⅞" T. & G. ceiling
2"x8" rafters spaced 15" c. to c.
#24 galv flat iron
⅞" dressed boards laid diagonally
8'2"
Cement mortar 6" thick
2"x4" studding spaced 2' c. to c.
9'2"
2"x4" studding on sides 4"x4" studding at corners and doors
⅞ T. & G. lining
⅞ Y. P. matched flooring
2 pcs. 2"x6"
2'11"
2"x10" joist
6"x8" sill
Ground
10'
B
SECTION C-D
C
Cement mortar
3"x6" air vents
Door hanger
Doorway
Outside covered with No. 24 galv. flat iron
Sheets 26" wide
1'6"
3'
⅞" T. & G. lining
2 pcs. 2"x6"
2" hard wood sill
⅞" Y. P. matched flooring
Similar stop on opposite side of doorway, provided with suitable slots for door hasp
Door stop angle iron
6"x8" sill
Iron 1"x3" bridging
2"x8" air vents
Ground
D
HALF ELEVATION AND SECTION A-B
10"
16"
9"
Not to exceed 5' span
18"
10"
16"
10"
16"
16"
10"
9"
10'
FOUNDATION PLAN
2"x8" air vents in foundation
Air vent 6" wide
Cover with ¼" mesh wire screen
2'
DETAIL OF CORNICE
Bolt trolley to perforated straps set in cement mortar
Trolley
Hasp for lock, pinned to straps
4'2"
SLIDING DOOR
⅞" T. & G boards
Cement mortar 3" thick
No. 24 galv. sheet iron front and sides
Thread ends of straps for nuts

Fig. 2—Plan and Sections of Bureau of Mines Cement-Mortar Magazine

6" thick in all walls and 3" thick in the roof and the door. The door is secured by two substantial locks. No metal of any kind is exposed on the inside of the magazine. The ventilators above the floor are arranged to prevent the entrance of bullets or firebrands.

The means provided for ventilation have been found to be adequate, and, accordingly, the storage conditions are favorable for keeping the explosives from deteriorating. The cement-mortar construction is effective in resisting the penetration of rifle bullets, and because of its friable nature offers an additional advantage for the reason that, in the event of an explosion in or near the magazine, large masses of material will not be projected over the surrounding country. The galvanized-iron covering is fire resisting; it also serves as an excellent medium for protection against lightning, as the four corners of the building are properly grounded with metal rods.

Thaw Houses in England and Germany

Magazines in England are generally substantial buildings with masonry or heavy brick walls, for the reason that the danger of explosion within a magazine is considered to come mostly from without. The buildings are constructed with a view to protecting contents from rifle bullets and from unlawful entry, lightning, and fire. The objectionable feature of this type of magazine is that in the event of an explosion within the magazine, large fragments of the heavy walls are projected over the surrounding country, endangering life and property in the vicinity.

In Germany many of the magazines are substantially constructed; others are of light wooden construction. Reinforced concrete construction has been recently adopted in buildings of this kind. In 1911 the Carbonite Explosives Co. (Ltd.), constructed at Schlebusch, Germany, 10 gravel-cement magazines, each having a capacity of 33,000 to 44,000 lbs. The gravel cement was made in the proportions of 3 parts cement to 2 parts gravel, no sand being used. This particular construction was adopted after two tests with a concrete magazine, the tests being made on the shooting grounds of Kümmersdorf in 1897. The tests indicated that no large pieces are projected by an explosion; the gravel cement was stated to be thoroughly disintegrated. The amounts of gelatin dynamite used in the two tests were 3,300 and 1,100 lbs., respectively.

Fig. 3 shows the substantial construction of such a magazine as that mentioned above. The figure also shows the ventilating system and the method of covering the magazine with earth. The reinforcement in the magazine is said to be a thin iron network, a construction that permits the use of thin walls. The earth covering adds an additional protection against flying débris. The magazines are 131' apart, center line to center line. They are in two rows of five each, and are staggered.

* * *

259. Sound-proof Tile Partition Walls

"In building a fireproof terrace at Youngstown recently the question came up of the best method of obtaining maximum sound-resisting partitions. Tile are being used for division walls, and we have wondered whether a tile laid with web vertical or web horizontal would make a better sound-resisting partition. The direction of the web would, of course, determine the direction of the column of air whether vertical or horizontal. Which would be the better way?"

259. Discussion by Charles Reier*

In my opinion the best way to lay the blocks would be with the holes laid vertically. My reason for this is that with the blocks laid in this manner a greater amount of continuous air (dead) space would be presented to resist the passage of air waves, naturally producing fewer surfaces which would act as resonanters of the sound waves. The accompanying table shows the comparative soundproofing value of various types of partition. The tests on which these data are based were made in 1895 at the Music Building, Chicago, and are still standard.

* * *

260 Grading Aggregates.

"In our concrete products plant we screen our sand and gravel to the following sizes: ½", ¼", ⅛", No. 20 and No. 50. I should like suggestions as to the best way to put these sizes together and get the best mixture—the densest mixture."

[We should like to know how many concrete products plants follow such a plan of screening their sand and gravel and re-mixing it in this way—and we shall be glad to have answers to the inquiry as to how this may best be done.—Consultation Editor.]

* * *

268. Ornamental Rubble Posts

"What is the best way to build ornamental posts of rubble concrete—posts 2' square and 6' high? I want to use cobble-stones about 3" in diameter for facing."

268. Discussion By G. O. Saunders†

The best and least expensive way to

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*New York.

†Boston, Mass.

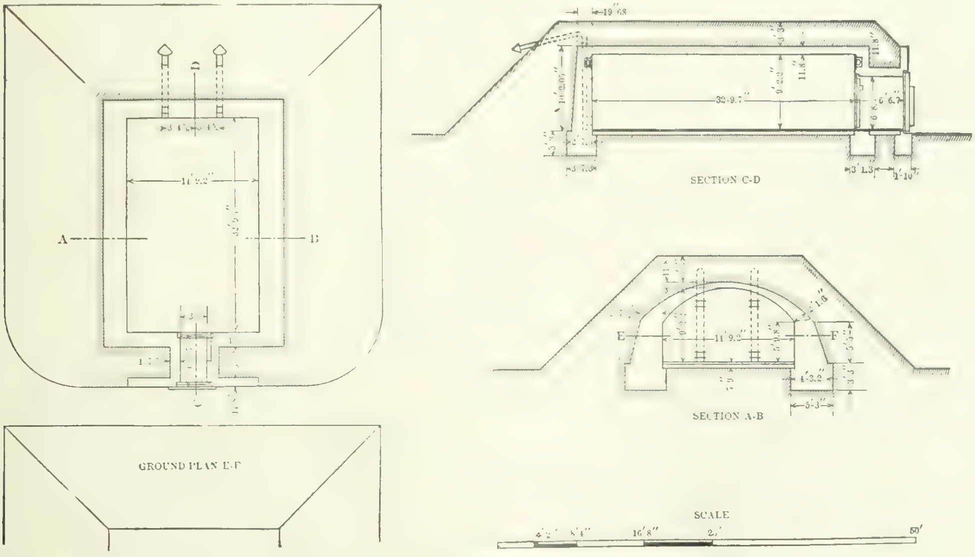
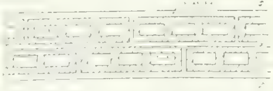
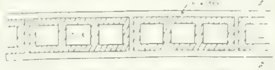
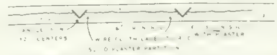
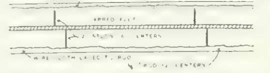
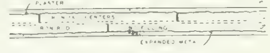
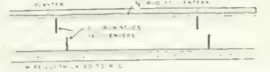
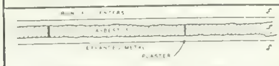
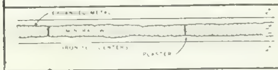


Fig. 3—Plan and Sections of Magazine of Carbonite Explosives Co.

TYPE OF PARTITION	[illegible]		[illegible]	[illegible]	[illegible]
	1.	COMMON MORTAR (CEMENT)	$1 40	23 23	$1 86
	2.	COMMON MORTAR (CEMENT)	70	23 23	1 16
	3.	COMMON MORTAR (CEMENT)	48	33 33	1 14
	4.	ROCK PLASTER COMMON MORTAR (CEMENT)	1 45 1 45	48 48 35 35	2 41 2 15
	5.*	ACME PLASTER COMMON MORTAR (CEMENT)	90 90	48 48 35 35	1 86 1 60
	5.*	COMMON MORTAR (CEMENT)	1 40	35 35	2 10
	5.*	ACME PLASTER COMMON MORTAR (CEMENT)	85 85	45 45 33 33	1 75 1 51
	5.*	ACME PLASTER COMMON MORTAR (CEMENT)	85 85	45 45 33 33	1 75 1 51

*Sound carried through due to metal connections.

Sound-Proof Tile Partition Walls
See Discussion 259 Previous Page

build rubble posts after the foundation is in is to take 4 pieces of 2″ x 4″ and 4 pieces of 2″ x 3″ and spike one of each together at the outside corners, making a shoulder 2″ wide on one side and 3″ on the other. Suppose a 24″ driveway post is to be built; set these pieces where each of the four corners of the post is to be. Set them out ⅞″ on each side, allowing for the form boards, making the distance between corners of studding 25¾″. Set these posts in the ground about 6″ and tamp well or stake around so they will not move. Then cut ⅞-in boards 25¾″ long and set inside the uprights on two opposite sides; then cut for the other side pieces 24″ long and place between the other side boards. This is to be only one board high, so that the work may be easily reached and the boards need not be nailed if the corners are firm and solid and braced both ways, with two braces, one in the middle and one at the top, or four braces to each corner post. Start with the mortar and lay the first course of rubble, selecting stones as to size wanted, being careful to keep them out close to form. Fill up inside the post with unselected stone or concrete and start another course and keep on until the post is finished. Let this stand over night and then take off the molds. With a wire brush, such as is used in foundries in scratching castings, brush out the concrete mortar between the stones about half the depth of the stones, being careful to have them all show the same amount of surface. When this is done, wash with a weak solution of muriatic acid to clean off any mortar or soiled stones and then wash with clean water. The corner posts must be carefully set and plumb both ways, as they are the key to the whole structure.

Tapering posts are made the same way, except that the corners are set at the proper angle both ways and boards cut to the right shape, one course at a time as the work progresses. When this class of work is well done, it has a very pleasing effect and when even fairly large cobble stones are used in foundations above ground, it saves time to have a similar form to lay the face of the wall against, as it keeps everything straight and each course can be leveled.

* * *

269. Power for Contractors' Hoists.

"What is the best power to use for a hoist on a concrete job? The building is 6 stories high and I want to use the hoist for the concrete elevator, and to handle centering and steel."

Editorial Comment.—Steam, electricity and gasoline power are in common use for hoisting, the latter being the latest addition to the field. In making a selection several points must be considered, among which are:

First cost,—

Maintenance and fuel cost,—

It may be of interest to note here that a steam boiler on the job can be fired to a certain extent with the scrap lumber that rapidly accumulates on any work.

Speed of Operation,—

This is very important on high buildings.

Ease of Operation,—

Labor Restrictions,—

A steam engine usually requires a licensed operator. In some localities both steam and electricity require union operators.

Handling Equipment,—

This involves the weight of the machinery, facility of moving, rapidity of "set-up," getting ready for work, etc.

Universality of Application,—

Steam and gasoline can be used anywhere. Electricity is restricted to localities supplied with electric power.

Winter Work,—

Steam heat comes in very handy in many ways, and it is a good thing to have a boiler on the work.

The question is one of considerable interest, and further discussions will be welcome.

269. Discussion by A. M. Kruger*

In regard to the merits of hoisting engines operated by various kinds of power, we regret that we are unable to submit very definite data on this question. To do this would require a rather extensive article to cover the numerous questions involved which affect the result. For instance the electric motor is being used in a great many cases where steam was formerly employed exclusively. This may, depending upon circumstances, produce a saving in operation over any other kind of power. A small unit operated for a short time with power purchased from a central station at a high cost per kilowatt will probably be an expensive installation if run continuously, while if current is required for short intervals only, a saving will result, due to the avoidance of attendance and other similar charges incident upon the use of an independent steam boiler. Again, municipal requirements may make the installation of electrical equipment imperative, regardless of relative cost.

In view of these and similar facts which usually determine the selection of the kind of power, conditions may entirely eliminate the question of relative efficiency and, from the selling standpoint, the selection does not, as a rule, depend upon absolute efficiency.

Without going into particular specifications, it is impossible to decide whether steam, electric or gasoline power would be greatest in first cost. In small units a direct current motor installation is comparatively low in price. The same outfit, with alternating current motor, will cost a great deal more, so much so that the first cost in this event may be greater than the cost of a very complete steam engine and boiler. The average first cost of a machine, whether steam, electric or gasoline, may be said to be about the same for any kind of power, while the actual cost in any particular case may vary considerably from the average.

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*American Engineering Co., Philadelphia.

Very similar conditions exist regarding the question of fuel consumption. A medium sized steam hoist, operated close to full capacity of the engine most of the time, can be operated economically. If power is taken from the engine only occasionally, or at a fraction of the power of the engine, the fuel consumption would make for inefficient operation.

Under such circumstances a gasoline driven machine will probably operate more economically; and an electrically driven machine, even if a high price is paid for current, would be economical, since no current is used during the intervals when coal would be burned under the boiler of the steam driven hoist. As an example of this condition, which large contractors aim to overcome, may be cited the usual method of using electrically driven units located at various points on a large job, all of which are supplied with power from a central station equipped with large, stationary boiler and engine plant. It is not unusual for contractors under such circumstances to install their entire generating plant.

In regard to speed of operation, machinery maintenance and ease of operation, these items can be taken care of by means of one kind of power as wall as by another.

From the above general discussion, it is apparent that we consider no user or intending purchaser of hoisting machinery can be certain of installing the most economical or efficient outfit for his needs, without submitting as complete data as possible, covering all the conditions involved, to the manufacturer, who will then be in a position to arrive at an intelligent conclusion.

* * *

279. Cement on the Pacific Coast

"What are the general tonnage, price and demand Salt Lake west to the Pacific Coast and from Seattle to San Diego on Portland cement, gypsum plaster and all kinds of clay products? I am trying to find out the demand for this tonnage and to be able to support my declarations by proof from a reliable source. These are 3 different industries, but similar in nature and the demand is growing. I would like some general figures."

279. Discussion by Edwin C. Eckel*

There are no official figures which cover the exact ground of this inquiry, but it is possible to make a fairly close estimate. This I have done, with the results shown in the little summary below. The area considered takes in the 3 Pacific Coast states, as well as Utah, Arizona and Idaho. The figures for clay products include brick, tile and other low-grade products, but not pottery. The question of importations should also be considered in this connection, but that may not be of interest in your present study.

The data are for total domestic production within the area in question, which seems fair since there is little eastbound sale of such products from plants located in the states named. On the contrary, there is considerable shipment from Colorado into that territory and when this fact is taken in connection with the importations of foreign cement, plaster and clay products, it is obvious that the effective demand is still considerably above the tonnage given in the table. The figures are as follows:

	Short tons.	Value.
Gypsum plasters	200,000	$ 1,000,000
Brick, tile, etc.	5,000,000	10,000,000
Cement -	1,400,000	10,000,000
	6,600,000	$21,000,000

279. Discussion by P. W. Rochester*

In regard to the cement business of the Pacific Coast, there are 14 cement mills west of the Rocky Mountains in the United States with an annual capacity of 8,000,000 bbls. or more, and 2 mills in British Columbia with a combined capacity of probably 600,000 bbls.

There are now in the course of construction 4 or 5 additional mills on the Pacific coast in the United States and two in British Columbia. The new mills in the United States will have a capacity of between 1,500,000 and 2,000,000 bbls. and the new Canadian mills will have a capacity of 600,000 bbls. or more.

This will give us a total capacity within the next 12 months on the Pacific coast of approximately 12,000,000 bbls. of cement and our annual consumption is probably not in excess of 7,000,000 to 8,000,000 bbls.

It is only by the most strenuous efforts of conciliation that the mills now operating have been able to maintain renumerative prices. While the market price on the Pacific coast is from $1.80 to $2.00 per bbl., the distances are very great and these are delivered prices. Considerable of the cement this year has been marketed at a net mill resultant of less than $1.00 per bbl.

Cost of fuel, labor and kiln linings are very much higher here than in the East and it is reasonably estimated that it will cost from 20c to 30c more per bbl. to produce cement here than at the average eastern mill.

* * *

278. Steel Forms for Concrete Cottage Construction

"We want information on steel forms for building solid concrete cottages. What we need is a low priced cottage suitable for working men, which can be let at a minimum rental."

278. Discussion by Wm. Mayo Venable†

In the construction of solid wall cottages there are several systems of forms in use; two methods are generally adopted and the one which will prove the best in any particular case depends upon the number of houses to be erected in one locality.

The larger corporations are providing a sufficient amount of forms to pour 1 story at a time, while the smaller builders are providing forms enough to pour not more than 4' (in height) of wall per day on any one building. It will be noted that the smaler outfit, of course, necessitates a very much smaller investment—in fact, on ordinary cottage work, a 2-course outfit can be supplied of sufficient size for ordinary work for between $450 and $600, according to the dimensions of the foundation, while for pouring a story at a time an investment from $1,500 up, according to the size of structure, is required. If there are many cottages to build, an adequate supply of forms should be secured in order that the work need not be delayed, no matter what method of handling the forms is adopted.

Most steel wall forms are adapted equally well either for 2-course work or for pouring 1 story at a time. They are usually designed so that the spacing of forms on opposite sides of wall and the lining up of the wall are accomplished automatically as a part of assembling the panels.

Under average conditions, it is possible for a man to set up steel forms at the rate of one panel of 4 sq. ft. each 2 minutes, this time including all of the work involved in lining up the panel ready for concrete. It takes a little longer to take down the panel and set it up again than it does to set it up only, but the entire process of shifting a panel can be conducted in an average of 4 min. by a man who understands what he is about.

The principal problem confronting designers of low priced concrete houses is concerned with the necessity of furring the walls and the advisability of providing reinforced concrete floors on all the stories. The reinforced concrete floor is considerably more expensive than a wooden floor, but *it is the only floor that is really fireproof and permanent.** Most of the builders of concrete houses, however, are building concrete outer walls only and using wooden joists to support the floors. These joists are built into the concrete wall on one end and rest upon studded partitions in the interior of the house. There is no reason for adopting this construction other than its cheapness. If reinforced concrete floors are used, the slabs would have to be about 5 in. thick on the living room floor and either 5 in. or 4 in. thick on the upper floors, according to the size of the rooms. These floors should be reinforced in the same way as factory buildings are reinforced, but the writer is strongly in favor of reinforcing the floors of dwellings with very light steel rods in both directions. This is advisable because, although the floor loads are light, they are apt to be concentrated more than in structures where heavy floor loads are counted upon.

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*Consult. Eng., Washington, D. C.

*Sec. Assn. Western Portland Cement Mfrs., Portland, Ore.

†Blaw Steel Construction Co., Pittsburgh.

*The italics are ours.—Editors.

280. Waterproofing a Boiler Pit

"I have a piece of work that a client wants me to keep the water out of. The water seeps through the brick and runs about 15 buckets an hour. How thick ought this to be plastered? What kind of waterproofing, if any, would you suggest to use? This is in a boiler pit and it is so low that it cannot be connected with the sewer. I believe that there is a spring opened close by."

280. Discussion by P. H. Hansen*

A cement plaster coat containing a good waterproofing applied on the floor and walls of this pit will make it absolutely waterproof, providing the water pressure can be relieved while the mortar coat is being placed. The amount of water which runs through the brick walls in this pit would not allow the mortar coat to adhere. If a means of restraining the water while the plaster coat is being applied can be devised, the operation of making the pit water-tight should be successful.

The floor is an easier problem. Here it is only necessary to dig a sump in the pit and drain the water into the sump, and then put an iron pipe into the sump and pump the water out of the sump through the iron pipe. Lay a cement mortar coat on the floor. Then fill the sump up around the pipe with concrete containing the necessary quantity of good waterproofing. Finally, plug up the pipe and then plaster over the pipe.

* * *

282. Concrete Tanks for Sauerkraut

"We are to build a concrete stave tank, to be used in curing sauerkraut. Can such tanks be made proof against the salt water and acids in the kraut?"

282.. Discussion By R. A. Plumb†

Concrete is, at the present time, quite generally used in this application. As an instance, a large Ohio company have more than 50 concrete tanks which it is using regularly for the preparation of sauerkraut. The kraut is made from a mixture of cabbage and salt and the brine that is formed comes from the juice of the cabbage. The fermentation of the cabbage lasts about three weeks, during which time there is naturally formed some organic acid which will have a slight effect upon the concrete.

We believe, however, that the use of an integral waterproofing, preferably in a dense waterproofed plaster coat on the interior, so as to minimize, to the greatest possible extent, the tendency of the concrete to absorb the juice, would make the application of concrete thoroughly efficient.

At the plant of the company mentioned it is the custom to paraffine the tanks annually and even if this were found generally necessary it would not be any serious handicap, as the treatment is very simple and inexpensive.

284. Winter Curing in Products Manufacture

"I am not prepared to install steam curing this winter for my block business. I shall have to heat my shop with stoves. How long should concrete products remain inside, protected from winter temperatures?"

284. Discussion by Charles E. Sims*

Your correspondent is handicapped without a system of steam curing and especially so in the winter time. If he is depending upon stoves to heat the rooms in which his concrete products are cured, he must recognize the fact that the heat is dry, drawing the water out of the concrete, which is detrimental to it and that the distribution of heat must necessarily be uneven, so that the products will not cure uniformly. Rather than put up stoves or use any system of dry heat, it would be far better to use a boiler—a traction outfit can be rented in any locality—and connect it up so as to throw steam into the curing room. But little more coal will be required by this method than with stoves, the heat will be supplied and moisture with it and the curing will be uniform throughout the room. Let the steam enter the room at the floor line, rather than above it.

In winter work, it is good practice to mix the concrete with hot water, thereby removing frost from the materials and quickening the cementing action. As cement is required, in standard specifications, to pass the boiling test, there is no harmful effect to be anticipated from the use of hot water and the nearer the boiling point, the better.

In specifications for cement products, we usually see 72 hours mentioned as the minimum length of time that concrete products should be cured before exposing them to freezing temperatures and by this is meant that the temperature in the curing room should be not lower than 60° for, as we know, the lower the temperature the slower the action of the cement, until at and below freezing very little crystallization takes place. If, then, the temperature can be maintained at 80°, 90°, or even higher, without drying out the concrete, the results are so much the better and the time could be reduced. Should it be impracticable to keep the heat up through the night, the time of curing must be increased, of course.

Frost not taken out of the materials when mixed will weaken the concrete and show itself by making the cured product crumbly as a whole or in spots. Freezing, after taking the products out of the curing room too soon, will weaken the concrete, due to the bulging action of the frost, and will be most harmful when repeated freezing and thawing take place. Some concrete manufacturers have not suffered loss even when their products have been frozen soon after making, but it is by no means safe to permit this to happen. After proper curing, there is no detrimental effect on concrete caused by freezing, except to arrest the process of hydration until it thaws again when the process continues to the same ultimate strength.

Technical discussions of the effect of freezing on concrete can be found in the files of our leading magazines, in the reports of government investigations and in books treating on concrete, so that a manufacturer of these products need not experiment and it is well to safeguard one's reputation by proper curing methods. Well made, wet, dense concrete, when cured, resists freezing remarkably well, so that it can be used in cold climates where other materials are at a disadvantage. Concrete drain tile, for instance, are being used more largely in the northern part of this country and in Canada today than ever before, and are going into ground subject to frost penetration from which other tile are by no means immune.

I hope that the above may bring out some differences of opinion so that the action of frost and the amount of curing may be discussed fully at this timely season.

A recent issue of one of the clay papers carries a quaint cartoon, representing little Johnny Concrete walking off with Miss Profit while the clay man and the clay worker fight in the foreground. The tremendous lesson of this strikingly original idea is hammered home by an editorial in Hearstian type. We quote: "The great trouble with the average clay product manufacturer is that he permits himself to keep an eye on his fellow clay-worker while he ignores his real enemy.

"Just as the cartoon shows, the foe walks away with the prize for which we should all be fighting while we are busying ourselves with petty disputes with our brothers.

"Better join hands, Mr. Clay Manufacturer, and fight the enemy with a united front. That is the only way to win the fair Miss Business."

This is surely a demonstration of a very pretty spirit. Of course, the best way to fight a competitor is to Donnybrook it and to hit a head wherever you see one. Relative merit of product has no bearing in commercial warfare. But why is concrete the brick man's enemy? We do not believe that concrete men think of brick men as enemies. On the contrary they are often highly entertaining and, even if somewhat noisy, enjoyable competitors.

The same brick paper carries a display advertisement, urging its subscribers to "fight fire with fire," and offering to furnish fuel in the shape of booklets showing the inferiority of concrete. The booklets should make excellent fuel, that being about the only purpose they can serve. All this talk by the clay interests would sound better and go further if their objections to concrete were based on anything but a frank admission that concrete cuts into their market and their profits. They can not sincerely say that concrete is dangerous to anything but a clay man's pocketbook.

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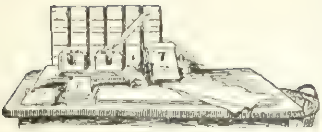
*Vice-Pres. Cerecit Waterproofing Co., Chicago.

†Trussed Concrete Steel Co., Detroit.

*Worthington, Minn.



CORRESPONDENCE

Spraying Freshly Made Block

As to the use of a spray in removing the film of cement and disclosing the quality of the facing material in the manufacture of concrete block, I give our methods as follows:

Immediately upon removing the block from the machine, place it where there will be a good light on the face and spray it, using a fine vapor spray, such as is used in spraying fruit trees. The outlet holes in such sprays are about the size of an ordinary pin and for the best results should be used in connection with a water pressure of 40 lbs. or more. This spray nozzle attached to a length of ½-in. hose is all the extra equipment needed and the spraying is a very simple operation which, with a little practice, can be done effectively by any intelligent laborer. The object and the effect of the spraying are as follows: It is well known that one of the greatest objections to the ordinary cement block has been, and is, its dull, lifeless appearance. No matter what kind or color of sand or crushed stone is used for facing, a certain amount of cement adheres to each grain, hiding the natural color and giving to the block the color of the cement used. White sand will give a lighter effect than dark sand, but in either case the entire surface is one color, dull and for many uses, unattractive.

Our process is to give a mottled effect, exactly the same as in fine, high-grade granite, where you see the black mica set off by the white or light gray of the quartz crystal in which it is embedded. The originator of the process described had for years the idea of spraying a green concrete block to wash the cement from the particles of sand, before it had had an opportunity to set, thereby accomplishing three things in one simple operation. First, to expose the color of the sand; second, to give to a semi-dry facing mixture the water needed to aid in the proper crystallization of the cement before the initial set had taken place; third, to remove mold marks and to give to the surface a roughened effect, equal to fine bush-hammering.

This process at first was of little value, when used with dark cement and ordinary sand, and it was not until white Portland cement came on the market and a suitable sand or crushed stone could be obtained, that it could be made of commercial value.

We have previously stated that the facing mixture should not be made too wet. Our reason for this is that we do not want to lose the cement from the face of the block, which, if the facing were too wet, would stick to the mold.

Our object in spraying is to wash this cement from the face of the sand and, by having the facing dry enough to come away clean, there will be suction created through the absorption of the water from the spray, which will carry the cement in between and around each particle of sand, not only uncovering its face, but allowing it to stand out slightly from the cement, thereby giving the cut-stone effect, before mentioned. If the facing is too wet, less water can be given with the spray and the tendency is for the cement to wash down over the sand, instead of away from it, and the whole to sag and run.

In spraying, where the facing has been properly mixed, watch closely and give all the water it will take without sagging. For the regular line of block, nothing more need be done except to cure in the usual way, either by steam or by sprinkling. For special and ornamental work, it is best to spray again, one or two hours after, and as soon as the cement has set so that there is no danger of its washing, give it all the water it will take. Turn the hose on all work that will stand it before closing the factory each night and again the first thing in the morning. This, of course, applies to work being cured by sprinkling and not by steam.

Steam curing is recommended. Spraying begins the good work by giving moisture when it is most needed, but it is impossible to give a sufficient quantity of water at the first operation, to penetrate the facing more than ¼". Steam completes the curing in the most satisfactory manner, by penetrating entirely through the stone, producing perfect crystallization. Sprinkling produces good results when properly attended to, but it is apt, by many, to be neglected or only half done. When sprinkling with the hose, be sure to cover all parts of the face and go over it several times, giving opportunity for the water to be absorbed, rather than run off the face and be wasted. The spraying process tends to make the face more nearly waterproof than any other method, except where special compounds are used, and it is therefore desirable to sprinkle as soon and as often as possible, before the cement has set sufficiently to repel the water.

Where steam is not used and it is desired to have some special pieces perfectly cured, we recommend giving them a bath by placing under water long enough to take up all the water they can possibly hold. Repeat the bath for several days and keep the stone in a damp place or cover them from the air and sun.

Another important advantage in using the process described is in patching broken or chipped pieces. In smooth, ordinary work, it is impossible to patch without it showing. With our process, if a corner or edge is broken down while making, first spray the part slightly, then apply the patch, doing as little troweling as possible, and spray the whole again.

The water will settle the patch and obliterate any dividing line. The same will apply to patching a stone broken after it has set.

The same effect can be produced on a block face up as on a vertical face and where there is facing to be done on the back of a block which is to be turned from the mold onto a pallet, it can first be sprayed, then placed on a smooth, clean pallet and all sides will come out alike.

On general principles we do not recommend the use of any waterproofing compounds in the facing of any concrete stone made by the semi-dry process, where it must get its strength largely from the water added after the stone is molded and during the process of curing.

When, however, it is desired to use such waterproofing compounds, use only those that will mix with water. Such as will not mix with water exercise the waterproofing qualities immediately and prevent the facing from absorbing the water from the spray, or that given by sprinkling. The facing therefore never gets water more than that given in mixing, which is not sufficient for the best results. Give plenty of water during the process of curing, keeping all work well soaked for a week or 10 days, when it will be as nearly waterproof as is required for all practical purposes. After being erected in the building, a liquid waterproofing can be applied if desired. It is recommended that block manufacturers using the spraying process give personal attention while experimenting and watch closely the change in appearance of the surface of the stone the instant the spray strikes it and also to note the amount of water that the facing will absorb before sagging.

The entire operation is simple, but effective, and adds little to the cost of production, while from 25 to 100% can be added to the selling price.

C. C. Thompson.

Syracuse, N. Y.

* * *

Concrete Fish Ponds

Referring to the letter of G. A. Hollinger* in regard to the failure of a concrete fish pond, there is no reason whatever why such a pond should not fail. In the first place, it is customary to condemn the cement, and while it is possible occasionally to get a cement that has not been properly burned, the general run of the leading brands are usually all right. He states that he used equal parts of Portland cement and sand, with a few small field stones mixed in and built a wall 12" to 14" thick. If he had used 1 part best Portland cement to 3 parts good, coarse sand and 5 parts gravel, with the sand sifted out of the gravel so as to get the right proportions, and made the walls 8" thick instead of 14" and built the walls with proper batter the pond would not have cost him half what the wrecked one did and would have been superior in every way. In mixing the concrete, first mix the sand and cement three times dry, then add the screened gravel in sizes up to that of walnuts and mix dry; then wet up and mix again thoroughly, using water enough so the mass will settle into the molds closely and without tamping. Make the pond with the sides sloping, like the third of an orange, having the upper part slope about 30° to 45° where the ice is likely to form, so that the thrust of the ice will exert a pressure upward, instead of against the walls. It might be advisable to cut out the clay around the outside of the walls near the top of the ground for perhaps a foot long and perhaps 3 feet deep and fill in with coal cinders. Clay is one of the worst earths to heave from frost. Have the bottom joints on a quarter-circle and no square corners anywhere. When the walls are in, take off the forms at the proper time and plaster up any holes where the gravel may come against the forms and when all is filled, apply two coats of a wash composed of 1 bag of cement and two shovelfuls of hydrated lime, put on like whitewash. Another thing, when ice gets to be 6″ thick, it is advisable to cut it out around the edges, so the ice cover will float and be cut loose from the sides. A little reinforcing within 6″ of the top of walls would add strength.

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*November issue.

G. O. Sanders.

Boston, Mass.

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Tile and Concrete Floors

Our attention has been called to an article* in an issue of your publication in which it appears that a recent article by Edward Godfrey, referring to a system of floor construction erected by us in the Berger building at Pittsburgh, was commented upon and the stability and virtue of the construction apparently doubted by a "Pittsburgh engineer."

In reply to this criticism, Mr. Godfrey is quoted as stating, "a mere recitation of the facts is criticism enough;" and the question is asked, "what takes the large, compressive stress at the top of a lot of tiles laid like a brick pavement and with the joints 'smeared' with mortar?" In the article referred to, Mr. Godfrey refers to a publication of ours called "Four Steps," and also to another catalogue called "One Hundred and Twenty-two Acres of Fireproof Floors and Roofs." Either of the publications above referred to is sufficiently explicit in describing how and why this system of construction has proven both economical and structurally sufficient for the purposes designed.

If the gentlemen in question have any doubts on this particular point, we would respectfully call their attention to a test† of a tile and concrete floor slab conducted by Robt. W. Hunt & Co., testing engineers, Chicago, in the spring of 1912. Accounts of this have appeared in the engineering journals.

A careful study of this test will disclose the fact that as a material in compression, medium burned terra cotta hollow tile is far superior to the best quality of Portland cement concrete and for the reason that hollow tile, commercially, will develop an ultimate strength of 6,000 lbs. per sq. in. in compression, while 2,000 lbs. per sq. in. is above the average compressive strength of commercial concrete floor slabs.

The test referred to discloses the fact that a properly reinforced terra cotta slab 12″ in depth and 2′ 7″ in width *without any cement finish on top* showed less deflection under a superimposed load under a span 24′ between bearings than was developed by 4 20-in. 65-lb. steel I-beams of the same length.

In view of this demonstration, it does not appear that there should be any doubt expressed regarding any of the methods of construction advocated by this company wherein a combination of terra cotta hollow tile properly proportioned as compression member, reinforced with steel to take up the tension stresses, nor that our statements should be unfavorably criticised or technically doubted. The identical construction used in the Berger building at Pittsburgh has been successfully used in almost every prominent city in the United States and the fact that the system has fulfilled the requirements of the original design and been found structurally perfect throughout the period of 12 years, should quiet any doubts in the minds of our technical friends.

Very truly yours,
E. V. Johnson,
Vice Pres. and Manager.
National Fire Proofing Co., Chicago.

[This letter was referred to Mr. Godfrey, who replies as follows: The Editors.]

In commenting on this letter from E. V. Johnson, it is pertinent to point out a few features of that letter that are, to say the least, misleading.

The test cited† was on a construction composed of solid reinforced concrete ribs with bent-up rods, filled in between with tiles. The floor I criticised had no such construction. It consisted of a thin layer of cement mortar with steel reinforcement in it, overlaid with a layer of tiles.

Mr. Johnson, in his 6th paragraph, would have us believe that the 12-in. by 31-in. slab of reinforced concrete ribs and tile is stiffer than four 20-in. 65-lb. steel I-beams. The facts are:

(1) The slab had overhangs at either end nearly 8 ft. long and very heavily loaded. These side loads very greatly reduced the deflection at the center of the 24-ft. span. The 24-in. beams were simply loaded in the center and had no relieving cantilever loads.

(2) The actual deflection of the slab was more than 1″. No 20-in. steel beam could sustain this deflection on a 24′ span and recover. It would mean failure.

(3) The calculated deflection of 4 20-in. beams from a center load of 41,443 lbs., the maximum placed on the slab, is 0.14 inches.

(4) The actual center load on these 4 20-in. beams was much more than double that on the slab, for it carried, besides the center load of the slab, more than 42,000 lbs. that rested on the cantilevers, as well as the weight of the slab and of the 4 beams themselves.

The tests cited are interesting. One tile wall stood 570 lbs, per sq. in. ultimate compression; another stood 292 lbs.; two others stood 1,354 and 1,215 lbs., respectively. This is a long way from 6,000 lbs.

It is a well known fact that when brick and tile are built up for test the work is done with a care seldom or never used "on the job." A few weeks ago, I witnessed a destructive test on a brick pier. The interior was solidly built and thoroughly flushed. The test load was high. A few days later I watched the building of a second test pier. The bricklayer dipped each brick in a bucket of water and carefully filled all the joints. I never saw a brick wall laid in a manner that even remotely approached this.

It is practically impossible to flush the joints between the open ends of hollow tile and cellular blocks. It is the usual practice to "butter" 2 or at the most 4 edges. Two failures are on record of chimneys built of porous blocks. The blocks were blackened on two or more sides by the smoke, showing that these two or more sides were never covered with mortar. Is it any wonder that the chimneys crushed and failed?

These are results that may be expected from dependence on ordinary building methods.

Edward Godfrey.

Pittsburgh.

* * *

Unit Slabs for Wall Construction

In going over past files of *Cement Age*, I noticed in the February (1912) issue† that reference is made to a wall slab system. The writer sees several objectionable features in the detail shown by your correspondent and begs to offer the arrangement shown on the enclosed sketch. (Fig. 1.)

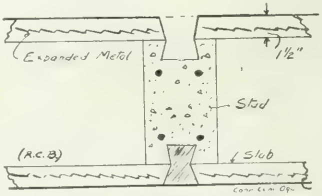

Fig. 1—Using a Concrete Toggle Tie in Unit Wall Construction

The chief objection to the fastening detail shown is that with this there would be a chance for moisture to collect around and on the nails which are used to hold the slabs in place. This would make a structure which is anything but permanent.

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*"Concrete Cover on Tile Floors," in this Department, Sept., 1912, issue.

†The results of this series of tests are presented on page 35 of the October issue.

†Page 107.

By referring to Fig. 1, it will be observed that the pilasters are molded in the yard and later set up in place, the slabs set up and the dove-tail of fresh cement plaster put in. An important feature of this arrangement is that if it is desired to tear down the structure in a few years, this dove-tail may be made of very lean concrete so that it may be easily removed, this liberating the slabs.

R. C. BEARDSLEY.
Engineer, Cleveland.

Editor's Note: Mr. Beardsley refers to a letter suggesting a new detail for unit wall construction which, to make the matter clear, is published below, together with the sketch (Fig. 2) accompanying the original letter. It may be noted that Mr. Beardsley's objection that the nail might rust seems to be anticipated by a notation in the sketch (Fig. 2) "Point-up joint when work is in place." The letter follows:

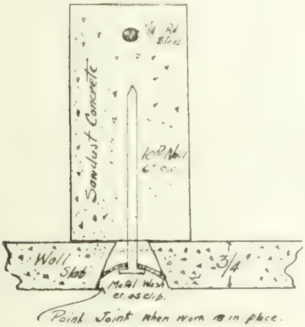

FIG. 2—SKETCH SHOWING SUGGESTED UNIT WALL CONSTRUCTION

The use of light slabs for wall construction offers many interesting possibilities, and the accompanying sketch shows a detail which, I believe, could be worked out very satisfactorily. I have followed the work of Mr. Wagner, at Toronto with much interest, also that of Mr. Beardsley, of Cleveland, and the only points in this suggestion with any claim to originality are the use of sawdust concrete in the studding which would allow nailing and the features of the nail and mortar joint.

The construction is very analogous to ordinary frame construction, using 2" x 4" and sheathing. This uses a concrete 2" x 4" (or any required size) and concrete sheathing, nailed on.

All the work is pre-cast and methods of erection would follow frame construction. Set the studding with the proper sills, stretchers, etc., and sheath them with the wall slabs. A washer is placed over the heads of the nails to hold the slabs in place. If required, a light wire could be run along the nail heads to reinforce the mortar joint longtitudinally. The stud could be reinforced to withstand handling and nailing if required.

The inside of the wall could be furnished just as a frame house is, using expanded metal or plaster board, and plaster.

Bulk Shipments of Cement

In *Cement Age* for June, 1912, it was my privilege to participate in a debate with E. B. Allen on the subject, "The Relative Economy of Paper Bags and Cloth Bags as Packages for Cement." The case for paper bags was so ably presented by Mr. Allen that I felt obliged to urge, as best I could, the advantages of the cloth sack, in order that both sides of the case might be presented as fully as possible. A careful reading of the arguments on both sides leaves one inevitable conclusion, however, which is that both packages are far from being satisfactory and that considerable items of loss and expense could be eliminated if their use were done away with. I believe therefore, that CONCRETE-CEMENT AGE readers will be interested in some observations that I have made on the shipment of cement in bulk.

In the past 3 months the Universal Portland Cement Co. has shipped about 15,000 bbls. of cement in bulk to the Nash-Dowdle Co. for its use in the construction of an ore dock at South Chicago, Ill. The Indiana Steel Co. has also used about 1,000 bbls. of bulk cement in the construction of engine foundations in one of its power plants at Gary, Ind., and some small lots have been used experimentally by other customers. In every case the verdict has been in favor of bulk cement. On the job referred to above, the Nash-Dowdle Co. has saved the labor of 1 man, and sometimes 2 men at the mixer, to say nothing of the other savings that result from the elimination of package losses and expense. The Indiana Steel Co. reports that its concrete is costing less per yd. when bulk cement is used than it did when cement was being bought in sacks. I have watched both these jobs with a great deal of interest, and my observation is that the use of bulk cement is thoroughly practicable and results in a saving in a number of ways. There appears to be an impression that the work of unloading and handling bulk cement must be accompanied by a great deal of dust, but my observation has been that it is no worse than the sacked cement.

The economies resulting from the use of bulk cement in this respect, are numerous. In the first place the initial investment for cement is 40c a bbl. less than if the cement were purchased in cloth sacks, and this is a point well worth the consideration of a man who is financing a job of any size. It is true that sacks are returned from time to time, but there must be at all times on a job, a great many sacks, both filled and empty. Each of these sacks represents an investment of 10c, so that in the aggregate a considerable amount of capital must be tied up in this unproductive way if sacked cement is used. Furthermore, there is a good deal of expense in keeping track of the empty sacks and returning them to the mill for credit, and there is also to be considered the loss resulting from sacks that are not returned at all, or which are returned to the cement manufacturer in such bad shape as to be unfit for further use, and for which, consequently, the cement user is not paid. On a job where sacked cement is used, all these items of lost property, lost capital, lost labor and unnecessary expense

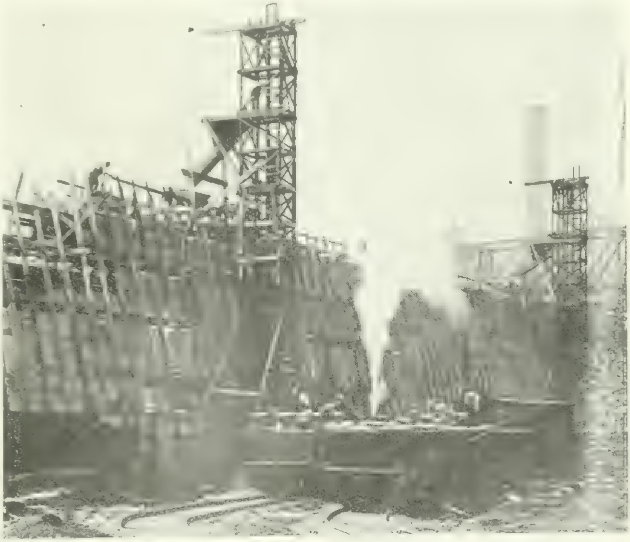

FIG. 1—HANDLING CEMENT IN BULK ON LARGE ENGINEERING WORK

must be added to the cost of cement in figuring material costs, and if they can be done away with through the use of bulk cement, the net cost of the material is bound to be reduced accordingly. If cement is used in paper bags there is a flat package loss of 10c per bbl., plus the additional loss and expense that results from breakage. When it is considered that cement must be reduced to a bulk condition in order to go into the mixer, the futility of putting it into sacks at the mill, only to be emptied out again as soon as it gets on the job, is apparent in a moment.

I appreciate very keenly that sacked cement has its place. I would not at the present time recommend bulk cement for the retail dealer, or for the contractor who has to rehandle or team cement, any more than I would recommend sacked cement for the man who does not need it in sacks. It is my firm conviction, however, that any contractor who is using cement direct from the car to the mixer, particularly in heavy concreting work, is wasting a lot of valuable energy and money if he continues to buy his cement in either cloth sacks or paper bags. On both the jobs referred to above, the cement was measured and handled in wheelbarrows, in the same way as sand. Both these jobs were under the continual and careful supervision of engineers and there was not the slightest fault found with the accuracy with which the various batches of concrete were mixed. I have seen bulk cement used in factories where concrete drain tile, sewer pipes, block and reinforced floor units were manufactured. Each of these factories was provided with only the crudest sort of make-shift equipment for warehousing and handling their cement but each has noted economies directly traceable to the use of the material in bulk, and the managers have expressed determination to remodel their plants and provide proper bins and equipment for handling bulk cement as a regular thing, at the earliest opportunity.

Another point that may be noted in connection with bulk cement is its comparative immunity from any kind of damage in transit. Every cement user has experienced the annoyance and trouble that results from cement sacks being torn or burst in cars, either through rough handling of the car in switching, through shifting of the load, or because of nails that worked out of the car floor and siding. Everybody knows what an unpleasant job it is to handle a carload of cement which has been shipped in a leaky car and which consequently has been damaged by wet. In cases of this kind the water that has leaked through the roof or siding of the car has run down through the spaces between the sacks, damaging every sack with which it comes in contact and making in each sack a lump of caked cement that has to be hammered out before the sack can be used again. Frequently the sacks themselves are utterly destroyed by the water, because nothing will damage a cement sack so completely as exposure to wet. Projecting nails and rough handling in switching will not have any effect on a carload of bulk cement. I have recently been present when two cars of bulk cement were unloaded that had been shipped in leaky cars, and in each case a considerable quantity of rain had leaked through the car roof. One of these cars was at Gary, Ind., the other at Cleveland. In each case, the net damage was ridiculously small. Under each leak was a small lump of caked cement, which apparently had absorbed all the water that had come through the roof, leaving the surrounding cement absolutely undamaged, and making it necessary only to lift out a small lump in order to leave the rest of the cement in good shape and ready for immediate use.

The opinion and observations that I have set forth above have not been expressed with the idea that they would be accepted as final and without question. I ask attention to them simply because I believe that in a general way they will be of interest to anyone who desires to do concrete work with a minimum of expense and a maximum of profit. Anyone who is in charge of concreting operations can size up his own requirements and the conditions under which he is working and decide for himself whether or not it would be of advantage to take his cement in bulk. The only recommendation that I would make (and I make that most earnestly) is that cement users give this question of taking their cement in bulk their careful consideration, and if they can see no reason why they should not handle cement in bulk instead of in sacks, that they back up their own judgment and make the experiment. As a guide in coming to a proper conclusion, a careful consideration of the following questions might help:

1. Is there any reason why I can't handle bulk cement just as efficiently and measure it just as accurately as I do the bulk sand, gravel and other materials that I use?

2. Every time a sack of cement is emptied into a mixer, the sack has to be untied, lifted up to the mixer hopper, tilted, held over the hopper while being emptied, shaken to remove as much of the cement as possible, and then the sack has to be taken care of, guarded against theft and damage, warehoused, shaken out, counted, bundled and shipped back to the manufacturer. Each of these operations has to be performed about 700 times for every carload of sacked cement that I get. Couldn't some or all of that unproductive labor be dispensed with?

3. What do I gain by getting my cement in sacks? Is this gain sufficiently large to offset the losses and expense that are due to sacks?

4. How much would it cost me to get the same results with bulk cement that I am now getting with sacked cement? How does that figure compare with what I know my present sack losses and expenses to be?

If these questions are carefully considered and honestly answered, a man will know whether or not be should continue to get his cement in sacks.

In the accompanying illustrations, Fig. 1 shows a job in which bulk cement was used with such good success that the contractor declares that hereafter he will never use his cement in any other way. This picture is interesting because it illustrates an ideal condition for handling bulk cement, that is to say, it shows a job of heavy mass concrete done with more or less stationary mixing plants, and with a proper track layout. Fig. 2 shows a wheelbarrow load of bulk cement being dumped into a mixer. The outlines of the wheelbarrow itself are somewhat blurred because of the fact that the barrow was in motion when the picture was taken. The most careful inspection, however, does not show any evidence of dust such as might naturally be expected. The only dust that was observable at all when the bulk cement was being dumped into the mixer was a small puff from the discharge side. On the day the picture was taken, there was a good stiff breeze blowing, but no dust at all was raised from the wheelbarrow while it was being wheeled from the car to the mixer.

GORDON WILSON.

Asst. Secretary Universal Portland Cement Co., Chicago.

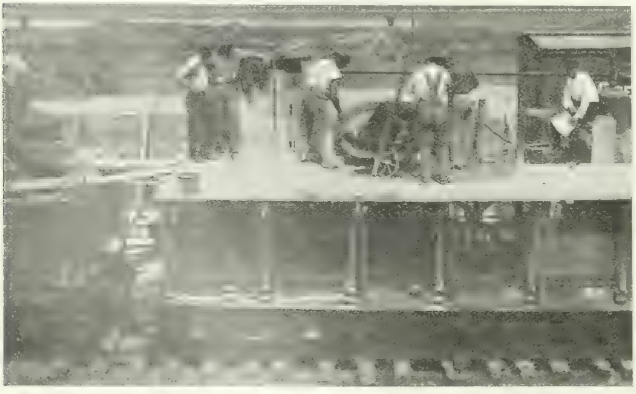

FIG. 2—DETAIL VIEW OF REAR OF MIXER SHOWING ABSENCE OF ANY DUST WHEN DUMPING

Concrete Roads of Wayne County[*]

BY EDWARD N. HINES[†]

It is a sad commentary on the conduct of an undertaking of any magnitude, that individuals, municipalities, states or nations, all seem to find it necessary to do a certain amount of experimenting and dilly-dallying before accepting the conclusions and avoiding the failures of previous demonstrations. This is particularly true of the various phases of the good roads movement.

With four years experience as a guide, we have demonstrated in Wayne county, (Mich.), that a well built concrete road is a practical form of construction which merits and will receive a more extensive adoption. Every test to which our work has been subjected serves only to emphasize its strong characteristics. The points considered, which might properly be termed a specification, are, initial cost, ultimate cost (which includes maintenance), sanitation and freedom from dust, good traction for all types of vehicles, smoothness and ease of construction.

The initial cost of a good concrete road is little, if any, greater than that of a first class bituminous macadam road. One of the greatest fallacies indulged in by communities starting to improve their highways is that cheapness in cost of original construction of roads means economy and that the highway official who can build the greatest area of roads at the least outlay per sq. yd. is working for the community's best interest.

On one of the main highays out of Detroit, Grand River road, the first two miles is tar macadam. *If someone had offered to build this road absolutely without one penny's cost to Wayne County, stipulating only that we should maintain it in a fairly average condition, at the end of eight years we would have been money ahead by rejecting the offer and building it of concrete under our present specifications.*[‡] Of course, six years ago when we built this road, we did not possess this knowledge but our experience was one of the reasons for abandoning the construction of this type of road and turning to concrete. When it comes to annual cost, the concrete road stands pre-eminent. With more than 60 miles of concrete road in Wayne county, some of it in its fourth year, we have spent less than $300 on its surface for maintenance and this is what makes this type of road the cheapest of all good roads.

Woodward avenue road, now in its fourth year, shows little or no signs of wear and it is not built nearly so well as our most lately constructed concrete roads. A conservative estimate of traffic on this road is that over 1,300,000 vehicles (more traffic than would go over an ordinary country road in 20 years), have passed a given point, without the development of ruts, holes or bumps and with the expenditure of next to nothing for surface maintenance. On this same road, Woodward avenue, adjoining our concrete at the Eight-mile road, which is the Wayne and the Oakland County line, Royal Oak township this year built two miles of asphalt macadam at a cost of well over $1.00 per sq. yd.; the first mile was opened for traffic August 17. Nov. 30 I went over this mile and counted 137 holes from 1 ft. up to 4, 5 and 6 ft. square. Fifteen men, a steam roller and a couple of teams were at work patching and repairing and the road is not four months old. If this record is not convincing as to the merits of concrete construction for roads, a test worked out recently in Detroit adds further testimony:

The Paving Determinator

About a year ago, as a result of the rapid deterioration of new pavements, the City of Detroit conducted an inquiry into materials used and methods followed in paving, and the Common Council of the city voted $600 for testing purposes to decide the merit or lack of merit of the various forms of built-up pavement. Boiler Inspector McCabe designed a very ingenious machine whereby all the conditions met with in street traffic could be reproduced as nearly as possible.[*]

The machine is made to revolve about a vertical shaft which carries, on a bearing, a head, which forms a bearing for the steel frame, at each end of which are jointed T castings. These T castings carry the shaft upon which solid cast iron wheels are mounted. The wheels have a 3-in. tire and carry a load each of 1,350 lbs. They are not supplied with springs or shock absorbers of any description. Each shaft also carried several plungers on which are mounted horse shoes, each one of which strikes a 75-lb. blow. The wheels are moved across the pavement by a train of gears. The measurement from outside to outside is 19′ 8″, the greatest wheel radius is 10′ 10″ and the least radius of travel of the inside wheel is 8′ 7″. It requires 333 revolutions about the circle to move the wheels across the pavement 2′, which is the limit of travel. The foundation of all pavements consists of 8″ of concrete. The paving is laid on 2″ of sand which is packed by a hand pounder until firm and uniform. The concrete sample is 6″ thick and laid on the foundation. In the first experiment, sections of cedar block, granite block, creosote block and three or four varieties of brick and concrete were tried out. *The Detroit Free Press* reports as follows:

"In the first experiment with the machine, it was run at a comparatively high speed to give it a severe test and the pavement which stood up best under this punishment was the concrete laid under the specifications of the Wayne County Road Commission. The wear on the surface was hardly perceptible, while the same wear on granite block and all brands of brick tried was as great as 1½″."

Maintenance

Whenever road builders, highway commissioners or others interested in highway construction get together, they talk maintenance, maintenance and more maintenance. While not belittling the principle of maintaining a road after it is built and following it out in practice, it seems to me, with Wayne county's experience, that it would pay other communities to adopt a form of construction on which it is not necessary to expend from $800 to $1,300 a mile yearly to keep it in fairly usable condition. Our concrete roads are sanitary, as there is no detritus from the road itself; there are few cracks and joints to hold dirt and animal droppings and there is no dust. The drier the weather, the less dirt on them, as vehicles do not track mud from unimproved cross roads in dry weather What little dirt is tracked on is immediately blown off or washed off by the first rain. Our concrete roads have a gritty surface and are not slippery in any kind of weather, affording good traction for all types of vehicles. Horses find good footing on them and automobiles do not skid in wet weather. It is not necessary to build concrete roads with any great amount of crown and the tendency to drive in one track, so apparent on macadam roads in the formation of ruts, is eliminated, as the driver of a vehicle can sit comfortably in his seat no matter on what part of the road he may be driving; neither can a horse pick out the beaten track as on a gravel or macadam road, but must be driven or he will zag-zag over the entire road. A crown of ¼″ to the foot disposes of the surface water and tends to distribute traffic over the entire area of the road. Another desirable feature of our concrete roads is smoothness. I desire to quote from a report of the Committee on Pavements, appointed in October, 1911, by Mayor Gaynor, of New York City, to investigate and report to him on the present conditions of the pavements of New York:

"No quality which a pavement can possess is more important than smoothness. Every irregularity in the surface is a source of weakness and of ultimate failure. As the wheels are drawn over the road, the wear which they cause is almost in proportion to the obstacle encountered. If the pavement is rough, as our stone ones are, or if it be broken, the wheels pound, and the pavement is subjected to heavy blows which soon wear it away and otherwise destroy it. In almost all our stone pavements, one can find places where the blocks have actually been crushed or split from this cause. If the pavement is of wood block, asphalt or any other composition material, and the surface is wavy, the depressions will hold water and speedily lead to failure; in such pavements disintegration almost invariably begins in these places. In macadam roads, depressions of this sort are the chief cause of wear, and especially so since the introduction of the automobile. The rapidly passing wheels throw out the standing water with great violence, carrying with it the binder or fine stuff between the stones, thus causing the pot-holes which make their appearance so rapidly on such roads when subjected to heavy automobile traffic.

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[*] Presented before the National Association of Cement Users, Pittsburgh.

[†] Member Board of County Road Commissioners Wayne County, (Detroit) Mich.

[‡] The italics are ours.—EDITORS.

[*] Described December, 1912 issue, p. 52.

"It should be remembered that since the advent of the automobile, smoothness for pavements is an even more important quality than it was formerly. The shock which a swiftly moving vehicle receives when it meets an obstruction, is more violent and destructive in its effects than if it were proceeding at a more moderate gait, and no matter how the force of the blow may be disguised from those riding in the car, by springs, pneumatic tubes or otherwise, the destructive effect of the blow remains the same, and is absorbed by some part of the mechanism, causing injury either to the tires or the frame.

"The loss sustained yearly by the citizens who use automobiles, by reason of the roughness of our pavements, must be very great in the aggregate."

Construction Not Difficult

With all the other good points in its favor, concrete can be handled with comparative ease and providing the work is carried on under skilled supervision, it can be laid with a working force of relatively unskilled labor It must be borne in mind, however, that the addition of a little cement to a quantity of stone and sand does not make concrete. There is no material which will respond so quickly to a little care, and if proper attention is given to the detail of mixing and curing, it will well repay you in quality and permanence.

Drainage and Foundation

Drainage and a good foundation are necessary for any type of road and on a concrete road the greater care there is taken in this respect, the better will be the final result. A well drained, well compacted sub-grade, will eliminate cracks to a very large extent. Drainage areas do not restrict themselves to township boundaries nor do legislative edicts concerning jurisdiction, and owing to the fact that our jurisdiction embraces Wayne County only and at the present time about 120 miles only out of a total of 1,370 miles of road therein, we have been handicapped to a considerable extent in both these problems. Our county is flat and although some few sections are sandy, the sub-soil is largely of a heavy, sticky clay, therefore not easily drained. As, at the present time, we have neither money nor jurisdiction to reconstruct the entire system of drainage and ditches throughout Wayne and the adjacent counties, we do the best we can under the circumstances.

Relative to foundation, we have had to build on fills and widen out roads on which a year's time in which to settle would have vastly improved conditions, but the immediate demand for the road is too insistent to permit delay.

One of the bad features alleged against concrete roads, is the tendency to crack. In order to overcome this tendency, we prepare our subgrade as carefully as conditions permit, making it flat and rolling it hard and firm. Owing to temperature changes and the absorption of water, concrete is constantly in motion and the flat subgrade tends to overcome frictional resistance and thereby prevents longitudinal cracking. On the first concrete road we built, we crowned the sub-grade to conform to the finished crown of the road and used what I term, for the want of a better name, an inverted curb. On this road and on the first concrete road built on Michigan avenue, where practically the whole road is built on a fill, we have developed more cracks than on all subsequent construction. These cracks, however, are well taken care of at a small expense, by the use of a hot, refined tar and sand. On our concrete roads, it is the repair of these cracks that has made up surface maintenance cost and with a well drained, well rolled, firm, sub-grade, cracks of all kinds are reduced to a minmum and are not to be seriously considered. We build our roads in 25 ft. sections to provide for contraction and expansion, believing it wise to make our lateral cracks beforehand so we can properly protect their edges from chipping and spalling. We are using a metal plate which is a development of previous experiments.* This plate is about 3/16 in. thick and 3 in. wide, provided with shear members which tie it securely to the concrete base and wearing surface. It is shaped to conform to the crown of the finished road and two thicknesses of 3-ply asphalted felt (about ¼ in.) are inserted between the two plates at each joint. By the use of these plates, we have practically overcome the wear at the joints, which are the weakest points in the concrete road, besides securing a smooth, even, continuous finish.

Wayne County is poor in good road material and everything has to be imported. We have secured the best results from the use of washed gravel ranging in size from ¼" to 1½" and washed sand from ⅛" down. We try to have our material well graded so as to secure a dense aggregate. Freedom from loam, clay or other foreign matter is absolutely insisted upon. We believe in a rich mix, using 1 part of cement to 3 parts of stone, with just a little more than enough sand to fill the voids in the stone. We believe that the details of mixing and curing the concrete have been as great factors in our success as any other feature. Our roads are constructed with a minimum thickness of 7". After our sub-grade is prepared, we place side rails of lumber 2"x7", protected on top by a 2-in. angle iron. The concrete is laid right on the natural sub-soil, which is well sprinkled just previous to placing the concrete to prevent the water in the concrete from being absorbed by capillary attraction. We use a wet mix that has been thoroughly mixed before being placed on the road. No tamping is necessary although we use a couple of men to work in it with shovels. We do not believe it wise or desirable to have the mortar and fine aggregate worked to the top, as it is the stone which we want to receive the wear. After the concrete is in place, no workman is permitted in any way to disturb the finished surface by stepping on it or throwing anything on it. We use a plank trimmed to the curvature of the road and iron-bound on the edges to give the road its proper shape. Two men saw this plank back and forth over the concrete, resting on the side rails or from boards at the sides of the concrete over which this strike-off rides smoothly. It is handled with sufficient care to eliminate the necessity for any considerable floating by the follow-up men. These follow-up men, or floaters, work on a bridge which rests on the form boards or rails at the side of the road so that there is never any contact with the concrete. The final "smoothing up" is done with wooden floats of home manufacture. When the concrete has become sufficiently firm to permit the removal of the side rails, the finishers, to prevent a sharp division line between the concrete and the gravel shoulders, pare off the outer edges which are formed next to the rails.

Each day's work is finished up to an expansion joint, and not more than 20 minutes is permitted to elapse between batches laid in one day. The work of the day is covered with canvas, and the next day the canvas is removed and to prevent the concrete from drying out too rapidly, it is covered to the depth of about 2 in. with any sand or loose soil that may be available. The concrete is sprinkled for 8 days and roads are not opened for traffic until at least 2 weeks after the last concrete is put in place.

Our trunk roads are built 16' wide of concrete and our secondary roads are built 15' with a minimum width of 24' over all. We have also built concrete roads with the metal 18', 12' and 10' wide. The shoulders are usually built of limestone or gravel in two layers of 3" each and rolled with a 10-ton roller. This work is not started until the adjacent concrete is at least 3 weeks old.

We do all work ourselves under the day labor plan and in parts of our busy season, employ as many as 1,200 workmen, handle from 900 to 1,000 cars of materials a month and build a mile of road, in the aggregate, every 3 days. Machinery plays an important part with us as we do not believe that a man should be set at a task which a machine can do as well or better. Stone, sand and cement are hauled from railroad sidings to the job by steam hauling engines or combination traction engines and rollers; graders, rooter plows and scarifiers are hauled in the same manner, doing the work of from 6 to 8 horses, more efficiently and more rapidly. Each concrete gang uses about 15,000 gallons of water a day which is pumped from the nearest available source. Two-in. pipe, with a tap every 400′, is laid along the road under improvement. Gasoline engines furnish the motive power and we have pumped water as far as 6 miles. Where we can find room along railroad side tracks, we operate a Brown hoist, with a ton bucket for transferring stone and sand to our hauling wagons. Concrete is mixed in a mechanical batch mixer which travels under its own power, and from which a boom projects, capable of being swung in a semi-circle. Our men are housed and fed in camps along the road side. We have worked out many other small economies, improvements and labor-saving devices which tend to keep the quality up and the cost down. All work is specialized; one crew prepares the grade; another gets the materials on the grade, which is done with such nicety as usually to make it unnecessary to haul in extra sand or pebbles to make a properly proportioned batch; another crew handles the concrete; another builds the shoulders, etc. By so doing, the men become more efficient as they become familiar with their tasks and we secure more and better work out of them.

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*The Baker plate, R.D. Baker & Co.

System is the key-note of our whole organization and when one considers that we are conducting a business enterprise, spending $600,000 a year with 1,000 to 1,200 men employed, working simultaneously at points 40 miles apart; that we are handling close to 1,000 cars of material a month, receiving daily reports, making up payrolls, tracing shipments, keeping crews supplied with materials, and handling a voluminous correspondence; that all these and other details of a big business, are handled in the office by four employes, at an expense to the county of $6,225 a year; some idea may be had of the methods employed. While there has been no intention or desire on our part to be extravagant or wasteful, yet we have done and will continue to do all things, which, in our judgment, seem desirable to give the people of Wayne County a system of goods roads, bridges and culverts, at cost, believing annual cost, rather than first cost, and permanency and utility, rather than cheapness, to be the ends sought.

Measurements of Expansion and Contraction of Roadway*

In connection with the experimental concrete roadway now being constructed by the Office of Public Roads at Chevy Chase, Md.,† an interesting set of observations is being taken on the changes in length of the concrete. Laboratory experiments conducted by the Office indicate that change in moisture content has much to do with the dimensional changes of concrete construction. In fact, when a reasonably rich mixture of concrete has reached a thoroughly dry condition, the change in length from its condition one day after pouring amounts to at least as much as would be caused by a fall in temperature of 100° F. It is not expected, however, that the concrete in the roadway will be affected by change in moisture content to any such degree as this, owing to its protection from a thorough drying out by the moist underlying sub-soil.

It is hoped that by accurately measuring the change in length of the concrete roadway, due both to temperature and moisture changes, data of practical value will be obtained to permit of more efficient spacing of the so-called expansion joints. In the experimental road at Chevy Chase, measurements will be taken over sections of plain concrete with gravel, limestone and trap rock aggregates and over sections having bituminous coatings, and also over sections of oil-mixed Portland cement concrete. For this purpose brass plugs 5″ in length and ¾″ in diameter are being embedded in the concrete just before the final floating and are spaced in double rows 5′ from the sides of the road, one row having a 10-ft. spacing and the other a 50-ft. spacing. The tops of the plugs are drilled with a 1/16-in. hole and are protected by means of a brass collar into which a rubber stopper is inserted.

Measurements are taken from plug to plug by means of a 10-ft. strain gauge. This instrument, which was designed to give an accuracy of .001″ in 10′, consists of two ½-in. tubes, one of brass and the other of steel, enclosed in a double brass casing, the diameter of the outer casing being 3″ and that of the inner casing 2″. Castings containing hardened steel points support the ends of the instrument, one casting being fitted with two micrometer heads and the other with two hardened steel plugs with flat ends. Readings are taken by resting the two points of the instrument in the 1/16-in. holes drilled in the embedded brass plugs. The double tubes, one of steel and the other of brass, are used to take care of temperature changes as readings are taken at different seasons of the year. The instrument has been carefully calibrated by reading on a steel gauge bar immersed in water at a constant temperature. Steam was passed through the inner casing and readings taken upon micrometers, and finally, cold air was likewise passed until the bars had both been reduced to the same temperature, when micrometer readings were again taken. From the result of this calibration means are at hand for judging of the average temperature of the tubes from their measured difference in length and a very accurate method is furished of reducing the micrometer readings on the road to what they would be if the temperature were to remain constant.

A view of the instrument is given in the accompanying illustration and shows the device in use on a newly laid section of concrete covered with earth which was kept wet through the initial stages of the hardening process.

Measuring Contraction and Expansion of a Concrete Road

Tree Dentistry

In an article on tree surgery in the *American City*, E. M. Swiggett, superintendent of Parks, Utica, N. Y., writes of the use of concrete in tree dentistry as follows: All cavities in a tree, large or small, should be carefully scraped out, treated with creosote, and finally filled entirely with concrete at the opening and as far up the trunk—if the cavity is in the trunk—as conditions will permit. The edges of large cavities are sometimes squared off and the concrete put on in such a way as to remind one of the way a dentist fills a tooth. This has led to the term, now in common use, "tree dentistry." Where the concrete cannot be made to stay in place, sheet iron may be cut to neat dimensions and tacked over the filled cavity, after which the entire spot should be painted with either light green or dark slate-colored paint.

In the work of his commercial geography classes in the Central High school of Kansas City, Mo., Porter Graves, vice-principal, is taking up the subject of the manufacture and use of Portland cement and is making use of educational literature and photographs on this subject in building up a commercial museum which is to be an institution in the school particularly for these classes.

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*Contributed by Office of Public Roads, Washington, D. C.

†Specifications published Sept., 1912, and Dec., 1912, issues.

Segmental Chimney Construction in France

The numerous advantages of reinforced concrete, due in a large measure to a fortunate combination of diverse properties, which are sometimes apparently even opposed, have assured it from the beginning a most important place in the different branches of construction. The new material, which possesses so completely so many good qualities not met with in ordinary materials, except in a small degree, could scarcely escape the attention of specialists and of engineers whose duty it is to produce the best installation and to render the best service for industrial firms.

As a result of the steadily increasing development of the latter, the problem of construction and of draft for chimneys is certainly one of the first and most important which can be put at the beginning of a study of industrial installation. As a matter of fact, the perfection of the utilization of fuel, and as a result of this, the extent of installation, depends to a great extent on the question of draft. That is to say, the chimney may be, throughout its existence, a continuous source of profit under proper conditions, or of loss under improper conditions, to its owner.

Chimneys made entirely of metal which might possibly realize to the greatest extent the two qualities of lightness and cheapness, possess disadvantages from use of thin shells, which, on account of the high conductivity of metal permit the easy escape of heat. There results from this a serious cooling of the stack gases on the inside. For this reason metal is not ordinarily used in works of great importance.

Chimneys of brick, on the contrary, have the advantage of low conductivity, but their stability is assured only by the use of material in greater quantity than is desirable or economical. The result is a large mass of construction which, in comparison with chimneys of tile or concrete, requires heavy and inconvenient foundation. More than that, even in brick chimneys which are protected with an extra grill-work, the variable wind stress, the contraction and expansion, and the unequal settlement of ground under the foundation, develop vertical and horizontal cracks in the casing, through which cold air penetrates, lowering the temperature of the stack gases, with resulting continual expense for repairs, and making the chimney useless before the construction material has worn out.

In reinforced concrete chimneys, we find all of the qualities necessary for good construction. As a result of the thinness of the shell, the total weight of the construction is considerably less than for a similar chimney of brick and as a result the extent of the foundation is materially reduced. Since the principle of construction is not dependent for the stability of the whole structure upon the total weight of the sections of the chimney, it is possible to make use of a total weight considerably less than is the case with brick.

The presence of vertical reinforcing rods anchored in the foundation, makes the reinforced concrete chimney a real monolith, the elasticity of which is a great deal higher than one of brick. Another advantage of this type of construction is that there is no danger of openings forming at the joints.

More than this, it is noteworthy that by a system of braces it may be so designed and built that if a concrete chimney varies from the perpendicular as the result of soil settling or unusual wind stress, it does not crack, while a brick chimney in all probability would. It is also possible to replace it in the proper position at a comparatively low cost.

Because of the poor conductivity of concrete, the draft is excellent in spite of the thinness of the shell and, in the opinion of specialists, a reinforced concrete chimney gives better results in this regard than a brick chimney of the same dimensions.

Cost of Construction:—One of the principal objections to reinforced concrete chimneys has been the high cost of form-work, and it is this high expense which has offset the economical advantages of this class of construction, retarding its progress.

As a result of this complaint, which is wholly justified, a number of firms have undertaken to substitute for wooden form-work a mold in which a considerable portion of the chimney's shaft may be cast. By this means chimneys are built in a cylindrical or tapering form, or they are built with varying thickness of shaft, which call for rather large quantities of material.

The firm of Leon Monnoyer & Son* has sought to overcome some of these difficulties and their system is so arranged that all form-work and scaffolding are done away with. By means of special devices and economy of material, reinforced concrete chimneys may be built at a price very much lower than those of brick. More than that, the materials to be used are in general more easily obtained than special bricks which sometimes have to be brought to the work from a distance. For example, the following comparison is interesting: In the case of a chimney 80

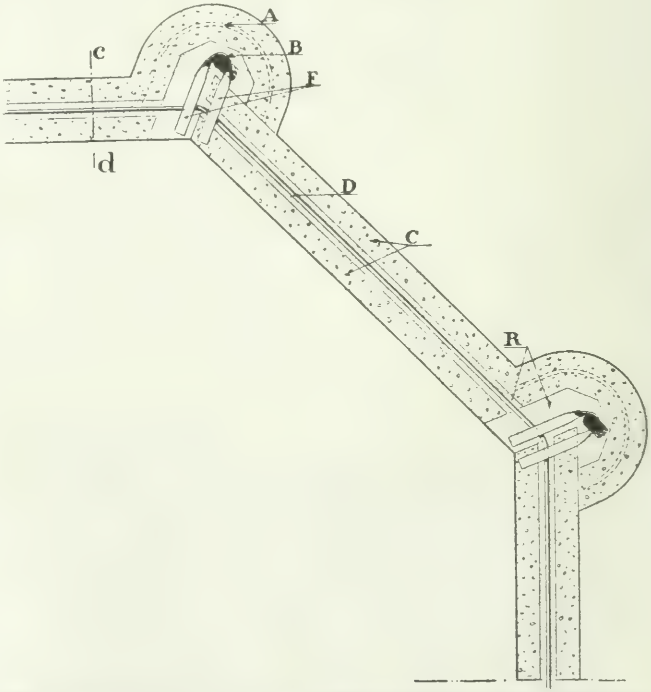

Fig. 1—Horizontal Section Showing Arrangement of the Segments and the Reinforcement
A is the reinforcement of the segment; B, the vertical rod; C, the segment itself; D, the continuous horizontal reinforcement; F, the loop tying the vertical steel rods into the structure; R, the concrete or mortar filled in the joints

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*Nancy, France.

m. (262′ 5″) high and 3.80 m. (12′ 6″) interior diameter at the top, to be constructed at Paris, the cost of erecting the work in brick would have been 60,000 fr. ($11,580) while in concrete it would not have cost more than 40,000 fr. ($7,720.). The difference is striking.

These chimneys are made like all the others, with a foundation, a base and a shaft. The foundation and the base, since they are built at ground level, present no special difficulties or unusual features. It is in the shaft that the details of construction are interesting.

The shaft is constructed of segments 25 c. m. (10″) high, the height for average diameters These segments (Figs. 1 and 2) which vary in number according to the diameter of the chimney, form, when assembled, a course 25 c. m. (10″) in height. Each segment bears at one end a grooved flange or "hook" which is placed on top of a similar "loop" on the segment immediately below it. These flanges thus form vertical ribs or "chases" in which are placed stiffening rods (B of Fig. 1). The latter extend the entire height of the shaft and are anchored both in the base and in the foundation. The rods are spliced so as to develop full strength in tension.

The chimney thus forms a monolithic block, the grade course of which is figured like that of any foundation.

In the shaft the length and the number of the segments vary according to the diameter of the chimney, and the number of exterior vertical ribs varies also. The system is so planned that no segment weighs more than 80 to 100 kgs. (176 to 220 lbs.) and the work of erection is easily done from the interior of the chimney by means of a simple block and tackle operated by a winch.

These segments are cast either in the workshop or in the field and are provided with embedded steel loops so that they may be transported without danger and put in place. Each course shows on its upper side a groove R in which a horizontal rod D is placed, and counter-sunk in the joint. Small stirrups or loops are indicated by F (Fig. 1) and tie the vertical steel to the segments at the rib. A light flat is used for this loop.

The courses are laid alternately (Figs. 2 and 3), that is, where one course is laid with the segments having the rib or head at the left, the next course has the segments with the rib or head at the right The end of a segment engages with the head of the segment which immediately follows it and may in this manner be engaged in the portion which constitutes the rib. This system permits variation of the diameter of the chimney at each course, using the same type of segment, thus obtaining the conical shape which is essential to a good appearance.

In a chimney 50 m. (164′) high it is not ordinarily necessary to change the length and the thickness of the segments oftener than 6 or 7 times. This makes for economy and speed in erection.

It should be noted that casting in place could not give the same conical shape without great expense, since it would be necessary to work constantly with conical casts and vary the diameter at each elevation of the form.

The work of erection is done very rapidly. The workmen are on the inside of the chimney receiving the segments, ready to put in place, and install them, concreting the 25 cm. (10″) of height of the corresponding rib, preparing the joint of a new course and thus may continue rapidly to place new segments. This rapidity of erection is one of the most important points of the process.

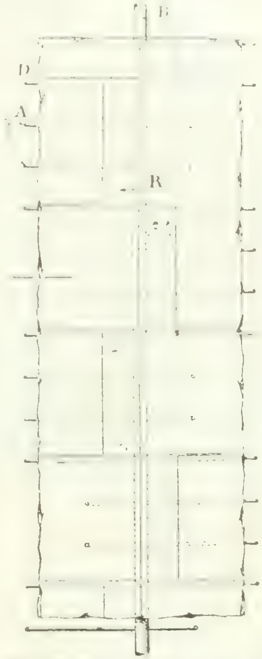


Fig. 2—Elevation of a Portion of the Chimney Opposite a Rib, Taken from Inside the Chimney
This shows the staggered vertical joints formed by the segments

Another advantage of the system is to have the vertical rods, which are the important ones, embedded near the exterior of the chimney so that it is certain that these rods are maintained at a temperature lower than that of the chimney proper, avoiding in this manner any bad effect arising from differences in expansion, which could not be avoided if the ribs were in the center of the mass of concrete. Theoretically, reinforced concrete is indestructible by fire as long as a temperature sufficient to disintegrate it is not developed. But it must be taken into consideration that, although the coefficients of expansion of cement and steel are practically the same, the coefficients of conductivity of these two materials are very different and disintegration may take place if the temperature of the metal for any reason exceeds that of the concrete. This consideration is of special importance in the particular case of a wall which is heated on one side only, as is the case in chimneys. Moreover, while it may be said that concrete in general is of course incomubstible, yet for chimney construction the concrete should be composed of aggregates of known heat-resisting and heat-insulating properties.

Architectural Chimney Construction

From the architectural point of view, these chimneys are very attractive in appearance. Their columnar shafts, of smaller diameter than those of brick chimneys, rise more gracefully from their foundations, while at the same time they have an air of solidity which is given them by their supporting ribs. They are finished at the top with a cap or cornice in cast metal.

To sum up, the advantages of this system of chimney construction are: Economy, great rapidity of construction, which may be carried on even in bad weather; longer life than that of brick chimneys, lower weight, with resulting cheaper foundations, a pleasing architectural aspect, a perfect draft resulting from the low conductivity of concrete, and the possibility of applying any necessary protective coating to resist any action of chemicals or temperature.

Applications of This System

With the economical advantages of their system of constructing factory chimneys established, the inventors went on to execute in segments every type

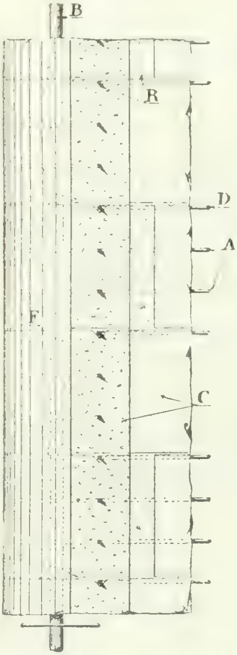


Fig. 3—This is Section cd of Fig. 1 and Shows the Rib at Left

of elevated construction, refrigerating plants, towers, and lighthouses, and particularly chimneys carrying reservoirs.

Refrigerating Plants:—The tower which is included in all refrigerating plants is made up of segments. The other portions of the structure are ordinarily constructed of narrow member which, like the segments, may be cast on the ground and afterwards put in place Without question, the price of a refrigerating plant constructed in this manner is higher than the price of a plant of the same capacity constructed in wood, but if it is considered that the construction in concrete does away with all the expenses and difficulties of maintenance and operation such as shut-downs, inspection and painting, one would advise any prudent firm to give preference to segment construction.

Stand-Pipe:—The conical tower and the outside shell are built up of segments or units of the same types as those used in chimneys and refrigerating plants described above. Often the walls of the reservoirs are constructed of segments without grooves.

At the upper part of the conical tower a grooved course supports the load of the reservoir by means of brackets and distributes this load uniformly over the shaft. The bottom of the reservoir is of reinforced concrete cast in place on forms.

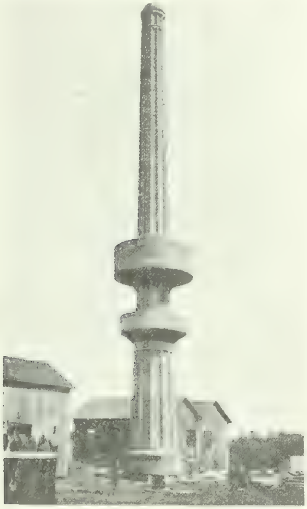


Fig. 4—A Segmental Chimney at the Mines of Anderny-Chevillon

The unique feature in this structure is the two water tanks built around the chimney

Dust Towers:—An Austrian contractor has built a dust tower in connection with a chimney designed to receive the gases from a cement kiln. These gases, heavily charged with dust, circulate about the chimney before entering into vent-holes. When they reach the latter they are already cleaned. In this manner, clogging of the chimney is avoided, also the necessity for frequent cleaning. Reinforced concrete, by reason of its non-conductivity of heat, is better adapted than any other material for use in dust chambers without producing a lowering in temperature of the stack gases, which would be detrimental to the draft and here, as elsewhere, segmental or unit construction permits the walls of this type of building to be erected with economy.

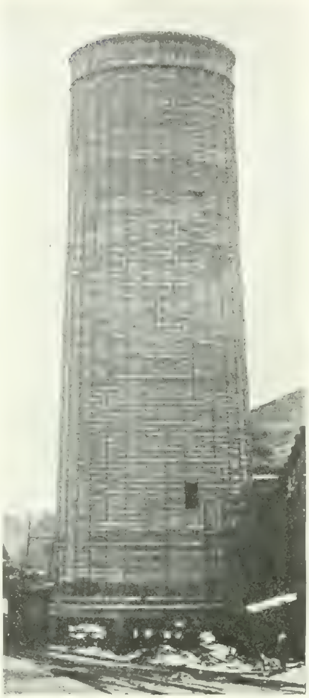


Fig. 5—Tower for a Refrigerating Plant at Longwy

Structure Erected

A description of pieces of construction built according to the Monnoyer system will show in detail the principal features and advantages of the system.

Chimney at Anderny-Chevillon:—This chimney (Fig. 4) which is 55 m. (180′ 5″) in height (See Figs. 1, 2. Pl. 1) offers one striking peculiarity, in that it carries two reservoirs, one of 100 cu. m. (26,420 gals.) capacity and 8.50 m. (27′ 11″) in diameter and the other with a capacity of 23 cu. m. (8,718 gals.) and 6.86 m. (22′ 6″) in diameter, the lower portions of which are respectively at 20.27 m. (56′ 9″) and 14.12 m. (46′ 4″) above the ground. These reservoirs are carried on ribs and form a unit with the shaft of the chimney. By this method there is avoided the necessity of constructing the masonry tower or the metallic frame work which would have to be put up in order to support the reservoir designed to contain water with the head required for the different uses of the mine.

The shaft of the chimney is conical and its diameter ranges from 4.20 m. (13′ 9″) at the base to 2.40 m. (7′ 5½″) at the summit. Its section is a 12-sided polygon, the angles of which are accentuated by strongly projecting rounded ribs. The general appearance is very pleasing.

Foundation:—The foundation and the base of the chimney are built in accordance with ordinary practice in use in reinforced concrete construction. The gases enter the chimney from two different sides and there have been arranged two entrances in the base of the chimney and a separate partition has

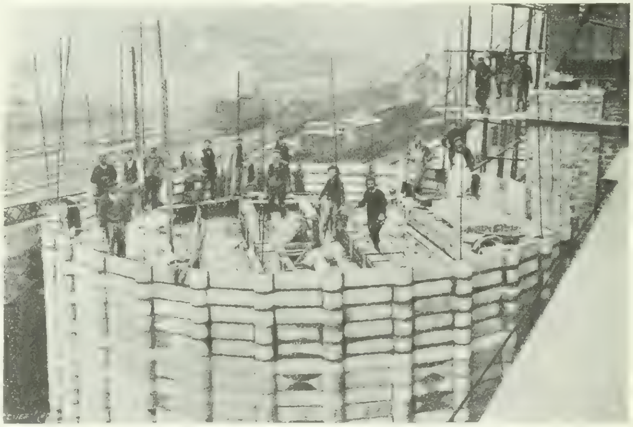


Fig 6—The Refrigerating Plant at Longwy Under Construction

This view is very typical of segmented construction been built to direct each current in the vertical direction.

Shaft:—The shaft is built. as already stated, in the section of a 12-sided pyramid.

Reservoir.—The reservoirs formed by the chimney at Anderny-Chevillon are constructed in the usual manner. In the part adjoining the reservoir, the shaft of the chimney is established by means of form-work to insure proper joining of the walls of the reservoir to those of the chimney. The reservoirs form closed chambers to which access is had by openings let in between the chimney and the interor wall of the reservoir. Ladders attached to the chimney give access to the reservoir from the exterior. An interior ladder is installed throughout the length of the chimney.

Service pipes, distribution pipes and overflow pipes are carried in the length of the chimney and go from the ground to the reservoir. It is easy to put them in place and to secure them because of the joints, into which attachments may be driven. The roof of each reservoir is furnished with four glass frames to light the interior.

Quantities Required:—The shaft comprises 2,460 segments, requiring 90 cu. m. (118.6 cu. yds.) of concrete and 3.5 tons of steel; the two reservoirs required 40 cu. m. (52.28 cu. yds.) of concrete and 3.7 tons of steel; the footing of the foundation 27 cu. m. (35.30 cu. yds.) of concrete and 2.5 tons of steel; the sub-base and the base 30 cu. m. (39.21 cu. yds.) of concrete and 1 ton of steel. An average of 10 men was employed on the work. The steel was worth 200 fr. ($38.60) a ton, not cut; gravel and screenings 15 fr. per cu. m. ($2.21 per cu. yd.) and the cement 45 fr. a ton ($1.63 per bbl. of 380 lbs). The order was given on a contract price of 23,000 fr. ($4,439.)

Refrigerating Plant at Longwy

This plant (Figs. 5 and 6) is characterized by a chimney open at its lower part, carried on a footing by 8 columns, the whole construction being in reinforced concrete. The chimney proper is 32 m. (104′) in height, 8 m. (26′ 2″) in interior diameter at the top and 10.70 m. (35′ 1″) at the base. Its horizontal section is a polygon of 32 sides. The supporting columns have a total length of 3.30 m. (10′ 10″). They rest on an octagonal foundation .50 m. (1′ 8″) in thickness, the lower level of which is 2 m. (6′ 7″) below ground. The tank for receiving the cold water is 9.85 m. (32′ 11½″) in diameter and 1.50 m. (4′ 11½″) high. The bottom of this tank is formed by the foundation.

The construction resists perfectly both heat and dampness as well as the frost which is produced in winter when the apparatus is not working. The watertightness is complete and prevents the filtration of the water or the solution to the exterior through the joints. This work was completed in three months.

Methods for Testing Concrete Waterproofing*

BY CLOYD M. CHAPMAN

So much that is contradictory has been said and written concerning various methods of producing concrete which is waterproof, and so much has been claimed by the makers of various compounds which have been offered to the public as a positive solution of all waterproofing problems, that it is not surprising that not one cement user in ten has any definite or fixed opinion as to how to meet the problem of producing a waterproof concrete. There seem to be as many opinions on the subject as there are men willing to express their opinions. And the many methods which have been used differ greatly from each other. They are not all bad, for some of them have been very successfully applied. They are not all good, for many failures have occurred.

Every little while a new preparation is offered or a new method is advocated. There seems to be no strong tendency toward any one method of producing a waterproof concrete. Perhaps the reason for this continued uncertainty and diversity of opinion among cement users may be found in the very fact that many of the multitude of methods advocated have, in certain instances, proven successful and each success makes converts to the method used. In many cases in which special compounds have been added to a good, well proportioned concrete made of properly graded materials, there is little doubt that the result would have been satisfactory if the special compound had been entirely omitted. In other cases where the concrete is made of materials not wholly adapted to the purpose an addition of a suitable filler or special compound would have produced the desired waterproof qualities.

To throw more light upon the effectiveness of the various methods of waterproofing concrete, a great many tests have been made by numerous investigators. The methods used by these experimentors have ranged from absorption tests to high pressure tests necessitating more or less elaborate apparatus.

Non-Pressure Tests

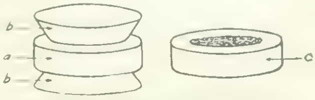
The absorption or non-pressure tests are made by preparing specimens of any predetermined size and shape of the concrete waterproofed by the particular methods under investigation. After the desired age is attained these specimens are either immersed in water completely, or immersed almost completely, placed in shallow water so that the bottom only of the specimen is wet. By one method, the specimen may be made cup-shaped so that the water may be placed in the depression in the specimen. As a development of this a container for the water is sometimes attached to the surface of the specimen. The two last mentioned forms of tests have been extensively used in the laboratory of Westinghouse, Church, Kerr & Co.

In all of these forms of tests the results are expressed in terms of the amount of water absorbed, or the rate of absorption.

Pressure Tests

In the pressure tests the specimen is either so made that the water pressure may be applied to the interior of the test piece or it is so made that it may be inserted in the apparatus in such a manner that the water pressure may be applied to a certain area on one face of the test piece. In this form of test the results are expressed in terms of the amount of water passing through the specimen or the rate of flow through it.

Both of the above classes of tests are very valuable if carried out in such a manner that the results may reasonably be expected to compare with results which may be obtained in practical work. To this end it is desirable that certain precautions be observed in preparing specimens and conducting tests so that the results shall not be misleading or deceptive.



Waterproofing Test Specimen with Exposed Surfaces

It is the purpose of this paper to call attention to some of the features of tests of this class which should receive particular attention and to emphasize more strongly certain precautions, failure to observe which may cause some of these tests to give very deceptive data. These precautions apply particularly to tests made for the purpose of determining what method shall be used on a particular piece of work in the field. Some of them do not apply to tests designed to compare the relative efficiency only of various methods without regard to any particular work at hand.

First: The selection of the materials to be used in making up the test pieces: These should be selected from those available at the site of the work which is to be done. This is particularly true of the fine and the coarse aggregates. It has more than once happened that tests made with suitable aggregates have shown a particular method to give a waterproof concrete but the same treatment failed when the aggregates available in the field were used. If, therefore, it is desired to determine by test how to produce a waterproof concrete for a particular job, the materials available at the job should be used in making up the test pieces. It is also important in connection with the selection of aggregates that there be secured a sufficient quantity of the materials to be used to conduct the entire line of tests contemplated so that there need be no change in the materials used.

Second: The proportioning of the materials: This should be done with a view to determining the proportions to be used later on the work. The proportions to be used on the job should be used in the tests. There is little use in testing a 1:2:4 concrete for water tightness and then use 1:2½:5 on the job.

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*Presented before the National Association of Cement Users, Pittsburgh.

†Engr. in Chge. Westinghouse, Church, Kerr & Co., N. Y. C.

Third: The mixing of the materials: This should duplicate as nearly as possible the mixing to be used on the work. Many a well-mixed concrete has proven waterproof which would have failed utterly if carelessly mixed. There is liable to be a tendency to mix very thoroughly concrete for a test and then make no special provision for thorough mixing on the job.

Fourth: The consistency of the mixture: This should be carefully considered because of its influence upon the results. A consistency should be chosen which it is practical to use on the job under the circumstances prevailing there. For instance, it is useless to test a concrete of so thick a consistency that it would have to be spaded into the forms, if on the job the concrete is to be spouted from the elevator and therefore necessarily of a much thinner consistency than was used in the test.

Fifth: The molding of the test specimen: This process should imitate as nearly as possible the filling of the forms as that will be done on the job. To make a test piece by putting into the mold a small quantity of concrete at a time and constantly tamping during the filling process would probably produce a deceptive result.

Sixth: The finishing of the surface to be tested: This is one of the most important points in the preparation of test specimens. The condition in which that surface which is to be subjected to water is left has a very great influence upon the results obtained. For instance, it is quite possible by means of a little troweling to produce a skin or surface coating of nearly neat cement. This will produce a dense surface much more nearly impermeable than the body of the concrete and show results far superior to an untroweled specimen of the same concrete. It is recommended that specimens be so prepared that the surface exposed to test truly represents the body of the concrete. This may be accomplished by removing the surface of the specimen after the concrete has hardened by means of a wire brush or by chipping or breaking off the surface before test.

In the case of absorption tests, this may be done with a stiff wire brush when the specimen is about 24 hours old. In the case of the pressure tests that portion only of the surface which is to be subjected to the pressure and that portion from which the water passes out of the specimen need to be removed. This may be accomplished by making the test piece with additional material added to the surfaces to be tested so that this additional concrete may be broken off after the specimen has hardened and before the test is performed. Unless some such precaution is taken, tests of this character are liable to show the efficiency of the surface of the specimen in resisting the water pressure rather than the value of the mass of the concrete in performing the same function.

Recommended Test Specimen

One suitable form for a specimen for pressure tests is shown in the accompanying sketch. It is in the form of a central disc *a* of suitable diameter and thickness. The outside surface and the outer portion of the two faces of this disc are molded smooth and regular so as to fit the receptacle or holder into which it must be placed in order to apply the water pressure to a definite and restricted area of its surface. From the central portion of the two faces of this disc project truncated cones *b* and *d* the smaller diameter of which is just equal to the diameter of the circle which is to receive the water pressure. After the specimen has hardened and is ready for test, the two truncated cones are broken off with a blow of a hammer, leaving a disc such as is shown at *c*.

By this method there is exposed to the water pressure a freshly broken surface of concrete which has not been subjected to troweling or other influences tending to alter the natural condition or distribution of the constituents of the concrete. This freshly broken surface is not only presented to the water on the side to which the pressure is applied, but is also provided on the opposite side where the water leaves the specimen. The test, therefore, is made on a certain thickness of concrete taken from the interior of the specimen and the results are not influenced by the method of finishing these two surfaces.

There are, of course, cases in which it is the surface permeability that it is desired to test and in such cases this form of specimen is unsuitable. But in all cases in which the watertightness of the concrete mass is to be determined the above type of specimen is much to be preferred.

There are also variations of this form of test piece which will accomplish the same result. Any method which removes the finished surface from the area to be tested is to be preferred to one which does not remove that surface.

Even in such cases as those in which the specimen is molded on a surface of glass or other smooth material and no troweling is done, there is a concentration of cement and fine aggregates next to the surface which must affect the results obtained if this richer layer or skin is not removed before test.

Seventh: The curing or aging of the specimen: This matter should also be decided with a view to conditions which will prevail in the field when the real work is done. If it is impracticable on the job to keep the concrete constantly wet for a considerable period, then the test specimens should not be stored in water. If the only wetting the work in the field is to receive is from the water contained in the concrete when it is placed, then the test pieces should receive no additional water after molding. On the other hand, they should not be allowed to dry out any faster than would the work in the field, as they would doubtless do owing to their comparatively small size if kept indoors in a laboratory and no precautions taken to regulate the drying process.

The specimens have now reached the stage when they are ready for whatever tests are to be applied to them and the methods used in performing these tests are so varied that the limited scope of this paper will not permit an extended discussion of them. Those with which the writer is familiar appear to be open to little, if any, criticism. One of the most important features is that the conditions adopted shall remain constant throughout the test.

If the test is an absorption or a non-pressure test, the immersion or partial immersion should be under uniform conditions and for definite lengths of time in clean water. If the test is a pressure test, the pressure should be kept constant, the water clean, and the method of measuring the water passing through the concrete accurate. As the area subjected to pressure is usually small, the amount of water passing is correspondingly small and in some cases where the measurement of the water is made by collecting the drippings from the under side of the test piece the element of evaporation may greatly affect the results. A form of apparatus in which the amount of water passing into the specimen is determined eliminates this error.

Pressure Test Equipment

In this form of apparatus the specimen is clamped and sealed to a metal cap which is provided with a projecting vertical graduated glass tube. The cap and the tube are filled with water and air pressure is then applied to the top of the tube in any desired amount. As soon as the specimen has become saturated and water begins to flow from its exposed face, a reading is taken of the water in a graduated glass tube and thereafter readings are taken at regular intervals of time throughout the period of the test. If it is necessary to introduce more water into the system when testing porous concretes, this may be done by opening an inlet which is supplied with water at a pressure higher than that of the air in the tube and so filling the glass tube again up to the zero mark.

By this method accurate determinations may be made of the amount of water forced into a concrete which is so nearly waterproof that all, or a great part, of the water which passes through it would be evaporated from the exposed surface.

Permanence of Waterproofing Materials

Another matter in connection with tests of waterproofings for concrete which seems to have had but little attention paid to it is the effect of time and the elements upon efficiency of the waterproofing materials. In practically all of the numerous tests of waterproofings made in the past 7 or 8 years in the laboratory of Westinghouse, Church, Kerr & Co., it has been the custom to expose the test pieces to the action of the weather on the roof of their office building, after first testing them, and then testing again after 6 or 12 months' exposure. The results of these tests after prolonged exposure show that few, if any, of the materials which are applied to the surface of concrete to waterproof it after it is made, will retain even a fair proportion of their efficiency. In the case of those methods by means of which the entire mass of the concrete is designed to be waterproof there is shown sometimes a steady improvement after exposure and sometimes a marked decline. In some cases the life of the treatment is very short and the failure after a few months' exposure almost complete

It is important, therefore, before any particular method of waterproofing be adopted, that the probable life of the treatment be ascertained. It is pretty well established that a good concrete without foreign substances in it improves with age, becomes more dense and water-tight, but the same cannot be said so positively of a concrete containing some of the recently developed compounds intended for waterproofing.

Concrete 50 Years in Sea-Water

In *Cement Age* for December, 1911, a concrete specimen made for the Crystal Palace Exhibition, Hyde Park, London, 1851, was illustrated and described This piece of concrete is now in the office of CONCRETE-CEMENT AGE, and from casual inspection looks very much like our present day gravel concrete. The material used was Thames gravel and English Portland cement.

Concrete in *sea-water* 50 years is of greater interest, and Dr. Goslich, director of the Stettiner Portland Cement Co., Zullchow-Pommern, Germany, in a recent letter, states that there is now in the German Museum for Nature Study and Technique in Munich, a block of concrete which had been exposed in sea-water for 50 years.

About the years 1858 to 1861, it seems, three seaports in Denmark utilized concrete dock construction, using Portland cement manufactured by the Stettiner Co., blocks 1 m. square being generally used and handled as masonry in dock wall construction. For the recent Dusseldorf Exposition, the Danish Minister of War, at the suggestion of Dr. Goslich, had a test and analysis made of one of these blocks, and the report of this test is attached to the block, and on exhibition at the Museum in Munich. As Dr. Goslich says it is interesting to note that a concrete block, after 50 years in sea-water, remains entirely intact.

The Long Island Ry. in its rather extensive work at Jamaica, had to support platform and station floors on filled ground, and pile foundations were used extensively. Investigation was conducted on the comparative value of creosoted wood or concrete piles. It was found that the pre-cast concrete pile could be driven for a total cost of about 50 cts. per linear foot. This type of pile has been adopted almost exclusively for this type of problem.

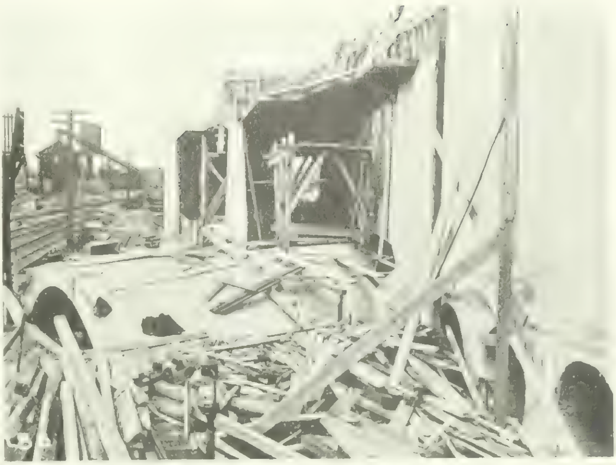

FIG. 1—DETAIL VIEW OF CONSTRUCTION WORK IN THE RAILROAD IMPROVEMENTS AT JAMAICA. The railroad is carried on an [illegible]. The cellular retaining wall construction is shown at the right.

Concrete in Railroad Work[*]

BY FREDERICK AURYANSEN[†]

The reputation of concrete for railroad structures is based on the sure foundations of:

(1) *Low cost:* It is cheap because its constituents are cheaper and easier to handle than the units required in any of the other materials usually involved in large work. This reduces the construction plant to a minimum.

(2) *Speed of Construction:* Not only is the process of mixing and placing concrete more rapid than that of building stone masonry, but delays in the receipt of particular parts are avoided, the forms can ordinarily be built to suit the changing phases of the work, and little if any extra expense is involved in caring for matters of immediate importance or urgency. Changes which would postpone the completion of wood, stone or metal structures for weeks or even months, can be effected in concrete with little delay, expense or risk.

Plans may be changed at the last moment without involving any considerable delay in the execution of the work, while other building materials have to be ordered in advance and when the channels of production are congested and orders have to be placed long in advance changes are almost out of the question, or are affected only at great cost either of time or money.

(3) *Permanence With Increasing Strength:* Steel structures require considerable annual outlay for up-keep, the neglect of which always proves to be false economy; while for most uses employing wood, its short life and increasing scarcity and value, combined with poorer quality, long ago made concrete a close competitor in railroad structures, where durability is a prime essential.

(4) *Adaptability:* A further advantage in the use of a plastic material such as concrete is that irregular shapes are comparatively simple of construction. In a skew arch, for example, the stone cutting is not a simple problem, while with concrete the principal thing to take care of is the proper disposition of the reinforcement, the regular forms being merely extended beyond the skew end and provided with slight additional bracing to take up the unbalanced thrust of the wet concrete. Concrete, too, can be deposited in masses as large or as small as desired, depending upon the size of the job and the capacity of the mixer, and it can be either deposited in place or molded into suitable shapes beforehand and placed after it has hardened. Highway bridges with I-beam floor construction which span more than two tracks, have heretofore been provided with intermediate supports consisting of steel columns and girders, which were encased in a concrete shell for protection. A logical development of this system has led to the adoption of thin reinforced concrete intermediate walls, with refuge openings if the length is over 60 ft. Three such are designed and will soon be built at a saving of $7,000 by omitting the columns and girders.

Concrete on the Long Island R. R.

The first considerable use of concrete on the Long Island R. R., was in the Atlantic ave. improvement begun in

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[*] An abstract of a paper presented before the the National Assoc. of Cement Users, Pittsburgh.

[†] Bridge Engr. Long Island R. R., Jamaica, N. Y.

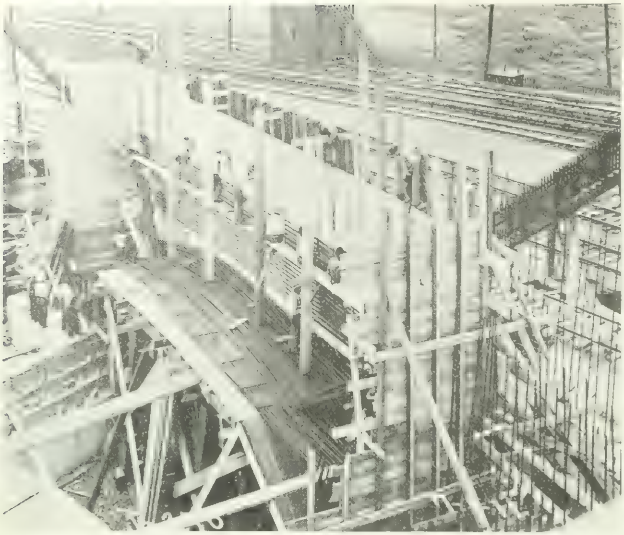


FIG. 2.—CONCRETE ARCH CONSTRUCTION ON THE JAMAICA IMPROVEMENT WORK
In this view the men are shown "lacing up" the wall steel

1901, whereby grade crossings for several miles through the city of Bro̊oklyn were eliminated. The construction included two subway sections, each approximately a mile long. While this work was undertaken shortly after the beginning of work on the original New York subway, the tunnel sections differed materially. The floor of the Long Island R. R. tunnel was paved with a concrete invert designed to take the thrust at the toe of the retaining wall, but it proved in addition to be very valuable as a foundation for the track, which, probably on this account, has required much less maintenance than track carried by ballast on the ordinary subgrade.

Foundation Work

The use of concrete piles has not been very extensive on the Long Island R. R. until the present year. In 1912 about 500 16-in., 28-ft. piles, some rolled and some cast on the flat, were used to support the five 1,000-ft. platforms of the Jamaica station. Being on a fresh fill of about 20 ft. to 25 ft. height, considerable settlement is feared; but the track grade being fixed, the platforms must be carried by unyielding supports and for these conditions concrete piles seemed particularly well adapted; and moreover, piles were estimated to cost less than longitudinal walls, even with generous openings, but with footings spread to reduce the bearing pressure to a safe value. As a further great advantage, the driving process compacted and settled the filling within a zone of 4 ft. to 5 ft. radius, so there is even less probability of settlement than was anticipated. Of 300 octagonal cast piles used, not one was broken either in handling or in driving and many of them were made in rather cold weather, about a year ago. There are now under construction about 1,600 more of various lengths for several structures about to be built on soft ground. As their cost is not over 50 cts. per ft. ready to drive, they will probably be used hereafter instead of creosoted wooden piles, where the permanent saturation of the ground is more or less uncertain.

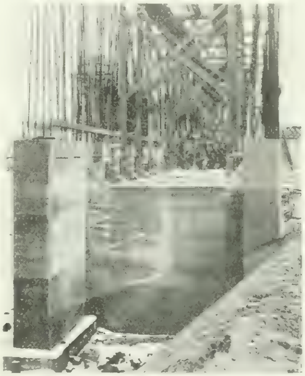


FIG. 3.—DETAIL OF THE OVERHEAD TRANSFER TRACK UNDER CONSTRUCTION

A problem of insufficient footings for a viaduct on filled ground is before us. What material but concrete could solve it? The proposition is to shore up the structure, column pedestals and all, and after excavating 2 ft. or so below insert either beams or rails unless by means of rods a simpler solution in reinforced concrete can be found.

Platform Construction

The five concrete platforms now being built at Jamaica will each be 22′ wide, and supported at 15-ft. intervals by bents of two concrete piles. The surface is inclined slightly from the center towards a line about 18 in. from the edge of the platform, and from this low point a rise of ¾″ to the edge of the platform is provided to prevent passengers from slipping towards the edge. The surface is checkered in 2-ft. squares to facilitate the escape of rain water and is also indented with a spiked roller to avoid the excessive smoothness of a concrete surface, which results from the attempt to make it dense and non-absorptive by troweling. Slipperiness is particularly objectionable on stairs, and on this account, in recent stair construction for the Jamaica improvement and elsewhere, instead of finishing the treads of concrete, blue-stone of a dense, sharp, gritty texture has been used. Experience indicates that these treads will last under heavy traffic for many years, and after they have worn badly they can be turned over and used again.

Track Separation

The diverging tracks in connection with the segregation of the east-bound and the west-bound traffic at Jamaica involve three "jump" crossings, two of which are reinforced concrete boxes of double tube section, the third being a steel frame and concrete deck structure which carries four tracks over the others. In connection with the first of the reinforced concrete boxes a peculiar condition was encountered in the foundation of its east end, which came directly over Maure ave., a street carried under the general elevation of the new yard through a 32-ft. arch. This construction would have been very difficult with any material other than concrete, but under the circumstances an extremely satisfactory solution was developed, the wing wall for the box being designed as a concrete beam to carry both its own weight vertically and the thrust of the earth horizontally. The Maure ave. arch was an interesting piece of work and though of only 32-ft. span, partly made up for this by its length, which is 510′. The centers consisted of steel ribs and wooden lagging upon which the reinforcing rods were assembled as frames and concrete poured in the ordinary way in sections of about 25 ft.; but the unusual length of the structure and the consequent duplication made it very cheap. Another similar arch 551′ long was built for Foley ave., and a third,

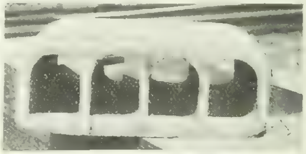
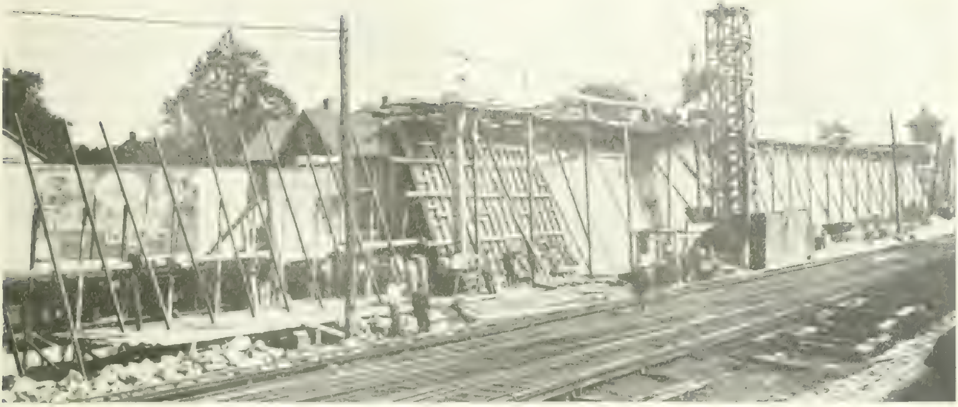


FIG. 4.—MODEL SECTION OF SUBWAY TESTED TO DETERMINE ECONOMICAL DESIGN



[illegible] Retaining Wall Construction
Note the vertical chute at the [illegible]

211′ long is projected for Church st., so that altogether the actual cost of form material for these three arches of 1,272′ aggregate length becomes almost negligible.

Subways

At stations and at some other points, public convenience demands crossings for pedestrians. At grade there is added to the danger from trains that of the third rail; the overhead bridge is usually unsightly, and people object to climbing; but they *will* go down stairs into a subway though the climb-out waits at the other end. A number of these have been built from 6 ft. to 10 ft. wide and about 7 ft. high. Concrete alone has been used during the last six or seven years. In some cases where the ground water level was only a foot or two below the track, the difficulty of waterproofing, while great, was successfully overcome.

Retaining Walls

To avoid the expense of piles, reinforced concrete wall footings have been very successfully used on Long Island R. R. work, extending them so that uniform pressures are obtained over the whole base. Generally column pedestals are of a depth to require reinforcement for tension but not for shear, this type being estimated to be cheaper than gravity sections. Where the soil is very yielding, an important factor in the design of a wall is its weight, which is a minimum with the reinforced type; the very thin walls with buttresses have but slight additional advantage over a wall of 20% section, and the latter is a great deal easier to build. Most of our work has employed gravity walls, but the semi-reinforced section, using either old rails or large sized rods is making a very favorable showing. On fresh filling and when the precise position of the wall is not vital, the lengthening of the toe is a simple and cheap expedient to avoid settlement of a wall. But when it is important for a wall to stay where it is built, the footings may be carried to the original surface through the filling, coring out a generous section of the foundation course. In one bridge foundation on soft muck where piles were used, the thrust of the embankments on the two abutments was balanced by concrete struts 3′ x 4′, carried on piles just below the street surface. Before the struts were finished the filling behind one abutment was begun, but was suspended when it was found that one wing wall had begun to rotate; this action was stopped by completing the struts.

Miscellaneous Construction

Round-house construction offers a particularly favorable opportunity for concrete. The Long Island R. R. is fortunate, however, in the tendency to extend the electric zone, reducing the mileage operated by steam, so there has been no new round-house construction for some time. While the products of the combustion of coal are injurious coal itself also is, both to steel and to wooden trestles, so that all new coal trestles on Long Island have either concrete piers, or the steel members are encased in concrete for protection.

Bumpers: To stop a train, there is hardly a better bumper than a pile of earth at the end of the track. But it is unsightly and perhaps not quite so positive as the Ellis bumper, which has been extensively used on Long Island.

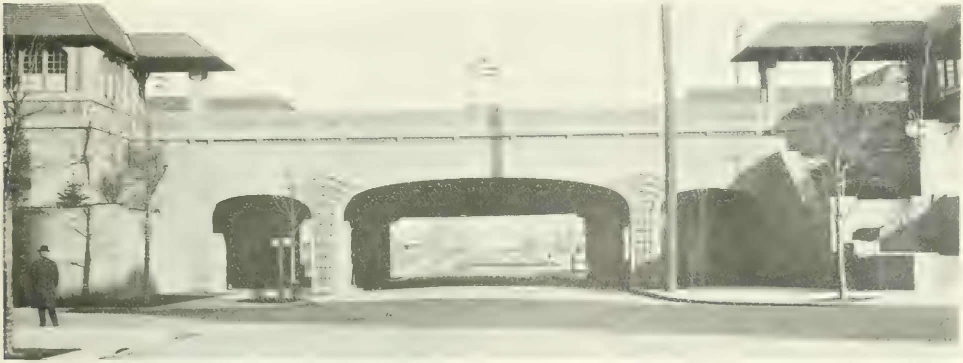


Fig. 6.—The Bridge at Station [illegible] Hills, Long Island
The panels of the rail are finished in rough [illegible] crushed red tile aggregate

As a new departure, several concrete bumpers are soon to be built if the full-sized test proves satisfactory. It is fully anticipated that the car will be tested to destruction.

Platforms: For low platforms, old 8" x 16" trestle timbers or new 6" x 12" have been used for curbing, but with the replacement of the timber trestles by concrete arch or slab bridges or by pipes, the supply of the second-hand timber is insufficient, and concrete curbing is now being used instead. The sections are 6" x 12" with a 3" x 8" core to reduce their weight. They are 10' long with a ½-in. rod 9' 6" long in each corner. The curbs and posts are molded in the stock yard and taken thence to the site, set to grade and line and bolted together, at a cost of about 50c per lin. ft. of curb.

Fences: One of the most satisfactory of the small uses developed for concrete is for fences. Right of way posts, for instance, can be made which cost only about 45c apiece, which means that the cost of the fence per linear ft. spacing the posts 20' apart and using woven wire, is as little as 10c. An elaboration for bridges consists in the use of galvanized iron pipe instead of the wire, but under certain conditions neither of these types is sufficiently exclusive. The small boy is at times strongly tempted to drop or throw stones at trains passing beneath a bridge, but a high concrete fence at the sides of the bridge shuts off his view of the results, and to that extent discourages his efforts; the passing of trains under a bridge is also more or less disturbing to horses; and the enclosure of freight yards by a visual barrier is important. For these reasons, the Long Island R. R. has built a great deal of solid slab concrete fence, spacing the posts, which are about 7 in. sq., approximately 10 ft. apart and erecting a 3-in. slab between posts. Former practice has been first to cast the posts in place and then the slabs in place, but it is difficult to hold reinforcement in the middle of such a thin slab and at the same time get the concrete thoroughly into the forms. In a few spots, the steel is too near the surface and has rusted enough to flake off the thin concrete covering. A contract involving 12,000 ft. of fence is therefore being executed now, pre-molding both posts and slabs flat on the ground, the slab rods being merely laid into the half-filled forms, which are then filled to the top. The intention is to locate accurately the post foundations, which will have cored holes to receive the rods extending from the bottom of the posts as dowels, the cored holes to be filled with grout before setting the posts. The slabs will be erected at the same time as the posts, making a simple and complete operation.

Sub-stations: Concrete has proved very serviceable in the construction of electric sub-stations on the Long Island R. R. The foundation walls are provided with all sorts of recesses and openings for the passage of conduits and many of the conduits are built directly into the walls and floors. The intricacy of the conduit systems, however, is all covered by the concrete envelope and the iron pipes serve to some extent as reinforcement, although they are not assumed to have any value in this respect. For the structures to carry the switches, brick has heretofore been used, but the expense of setting pressed brick with the desired accuracy was so much greater than that of ordinary brick work that concrete slabs cast in the same manner as the fence slab have been used with great success for this detail.

Pipe: Concrete pipe for culverts has not proven altogether desirable. It is so heavy in the large sizes that a crane is required to handle it and the consensus of opinion appears to be that cast iron is cheaper in place than concrete pipe.

Cattle Guards: For cattle guards it is found that triangular sections 5" high and 8' long, reinforced with 3 ¼-in. rods are very satisfactory. Niches are left in either edge about 6 in. apart so that one spike suffices to hold both adjacent guards. The ends are rounded off to prevent unsightly breakage. These are giving better service than either the old wooden guards or the newer vitrified sections.

Plant Arrangement

The method of handling concrete which has for some time past been favored by the Long Island R. R. construction department is to set up the mixer in a pit, so that the ingredients can be either wheeled to it in barrows or delivered in small narrow-gauge cars which are loaded with stone, sand and cement directly from the cars in which they are delivered. After mixing, the concrete is hoisted in a bucket, and discharged into a hopper, being fed thence into buggies and wheeled along the various runways to the desired point.

Surface Finish

The appearance of frame structures is generally inferior to that of concrete structures for two reasons: 1st, if the maintenance of the former is curtailed, the appearance is greatly marred; and 2nd., ordinarily the lines and surface finish cannot be made so pleasing as with the concrete. The usual practice on the Long Island R. R. is to rub the surface with a carborundum brick, wetting with plain water during the operation. A brand of cement has been in use for two or three years which has given exceptionally white surfaces under this treatment and altogether it has proven decidedly satisfactory. For a bridge recently begun, the foundations will have a surface finish approximating that used for bridges that have been built in Philadelphia for several years past, but with architectural treatment in addition to the surface finish.

Architectural Effects

Concrete lends itself very readily to obtaining attractive effects; for instance, to save material, piers may be pierced with arched openings with a very pleasing effect, although, of course, we know that no arch action takes place. Likewise, a plate girder bridge which would not have a particularly pleasing outline may be hidden by a screen of concrete, enhancing its appearance very materially at comparatively slight cost.

The Continental ave. bridge is at Forest Hills, near Jamaica, where the Sage Foundation Homes Co. is developing a beautiful suburb. The combination of red tiled roofs and brick panels with the gray concrete of which the houses are built makes a very pleasing effect, the warm tone being repeated in the stucco work on the bridge, by mixing in a considerable proportion of the red roofing tile, broken into small bits.

Fireproof Residence Construction.

The house illustrated, which was planned and built at Henderson, Ky., by C. F. Kleiderer, is an example of durable construction—a feature which will become more and more appreciated as people learn what a waste it is to build up, patch and tear down, only to begin a new round of similar procedure. Mr. Kleiderer expresses himself as perfectly satisfied with his house except in one particular—if he had it to build again he would use concrete beams to support the concrete roof slab instead of timber framing. Otherwise the house is fireproof and gets an insurance rate of 30c. per $100.

The outside walls are of concrete block, the inside surface being plastered directly upon the block without furring and lath. No dampness has ever been evident though in some climates lath and plaster furred out from the walls are necessary when there is danger of condensation through insufficient insulation.

The porch seen in the front extends entirely around the 2 front rooms and affords ample protection from the sun. The girders supporting the porch roof are of concrete, as well as the ceiling, columns, floor and steps.

Concrete House Which Cost $3,800

Concrete Grain Elevator Construction*

BY R. P. DURHAM†

This paper is a general review of the beginnings of concrete elevator construction and its subsequent progress, paying particular attention to the building of bin walls with moving forms, which is the feature making concrete elevator construction so different from other forms of reinforced concrete work. I shall not go into technical points in regard to design of bin wall concrete, reinforcing, etc.

I shall have occasion to refer to the work and experience of our competitors and in so doing I may be guilty of some inaccuracies for, unfortunately, we never know *everything* about what our competitors are doing, but there will be no intention to make any misstatement nor to withhold credit where credit is due.

Early Elevator Construction

Reinforced concrete grain elevator construction in the United States had its beginning in the very closing years of the 19th century. Prior to the starting of this form of construction in America, certain concrete grain storage bins had been built in Europe which were, in their main essentials, practically the same as those built later in this country, except that the individual bins were generally smaller, both in plan and in height, than the average size of bins built on this side of the water. Neither was the total size of the complete building what we should call large. The mechanical appliances for handling the grain exhibited considerable difference from those used here; and, perhaps most important of all, the method of carrying out the construction differed very materially from the means which are now almost universally employed in the United States.

In the years 1899 and 1900 the construction of reinforced concrete bins was started practically simultaneously by three engineers working independently and at different points. One building was not for storage of grain but should be mentioned here as being essentially similar to a grain storage building and being one of the earliest examples of this form of construction. This building was the cement storage plant for the Illinois Steel Co., Chicago, designed by E. L. Heidenreich and constructed under his supervision. It consisted of 4 bins 25′ 0″ in diameter inside, with bin walls 53′ 6″ deep, 7″ thick for approximately one-half the height and 5″ thick for the balance of the way. Before actual construction of this work was started, F. H. Peavey, the well known grain merchant of Minneapolis, sent a representative to Europe to investigate the progress which had been made there in the construction of concrete grain bins. A thorough study of the situation was made and on the return of the investigator Mr. Peavey, with his engineer, Mr. Haglin, built as an experiment a single concrete bin adjacent to one of the Peavey elevators at Minneapolis. As this was successful, construction of a large reinforced concrete grain storage elevator in connection with one of the Peavey elevators at Duluth was proceeded with. Unfortunately a portion of this elevator collapsed the first time grain was put into it and this, in spite of care in loading and various means used for strengthening the structure, was repeated on more than one occasion thereafter. It is not necessary in the present paper to discuss the reasons for the failures further than to say that they were not caused by any lack of adaptability of reinforced concrete to this form of construction, but rather by unfamiliarity with the action of grain and the proper method of reinforcing to carry the pressures.

The third set of concrete bins built at this time was in a small grain elevator built for the George T. Evans Milling Co., Indianapolis, by John S. Metcalf Co., Chicago. It consisted of 4 cylindrical bins 26′ 0″ in diameter inside and 47′ 0″ high. The inter-space bin between each pair of the four cylinders was used for grain storage. These spaces were also used in the Peavey elevator and it was, in fact, the use of these spaces without full knowledge of how the grain in them would act which primarily caused the various collapses.

So new was the construction of concrete grain bins that in taking the contract for the small elevator at Indianapolis the John S. Metcalf Co. was obliged to guarantee the building for 8 years. The elevator was in every way satisfactory and may be called the first successful concrete grain elevator in this country.

The trouble with the Peavey bins necessarily retarded the development of concrete elevator construction. Grain companies and railways building terminal elevators, naturally enough, in the absence of full information as to the reasons for the failure, laid the trouble to the materials used.

I believe that the next reinforced concrete elevator was one built by the Barnett & Record Co., Minneapolis, for the Canadian Pacific Ry. at Port Arthur, Ont. It consisted of 9 cylindrical bins 30′ 0″ in diameter and 90′ 0″ high with bin walls 9″ thick. The inter-space bins were also used for storage and the elevator was in every way satisfactory. This construction was completed in January, 1904.

In the meantime the construction of fireproof grain bins by using tile walls was progressing so rapidly under closely held patents that builders who were not in position to use this form of construction were continuing their investigations of the use of reinforced concrete as a competitor of tile. In 1904 the John S. Metcalf Co. built for the Missouri Pacific Ry. at Kansas City, Mo., a reinforced concrete elevator of 720,000 bu. capacity. This consisted of one long line of 10 cylindrical bins independent of each other except as to foundation, each bin being 40′ 0″ in diameter and 80′ 0″ high. From that time to the present by far the largest proportion of terminal elevators and storage elevators for mills have been built of reinforced concrete, gradually displacing construction of wood, steel and tile. The small country elevator is still largely constructed of wood, although the Macdonald Engineering Co., Chicago, has recently built two or three country elevators of reinforced concrete and its representatives state they can be built economically and rapidly of that material.

Rectangular Construction

Owing to supposed difficulties in reinforcing rectangular concrete bins, there were for several years few concrete grain bins built which were not of cylindrical form.

About the year 1907 J. H. Tromanhauser designed and built a 500,000-bu. elevator at Goderich, Ont., in which the bins were rectangular in form. The walls in this elevator were designed so as to be thicker at the center of the span than at the points of support. In 1908 John S. Metcalf Co. built for the Grand Trunk Ry. at Tiffin, Ont., an elevator with rectangular bins and straight walls 8″ thick. Within the last two years a number of rectangular bin concrete grain elevators have been constructed; the most notable example is the recently completed 2,600,000-bu. elevator for the Harbor Commissioners of Montreal.

There is at least one concrete elevator in the United States with bins which are hexagonal in form. This is an elevator built some years ago by the Macdonald Engineering Co. at Nashville, Tenn.

Concrete Now Used Exclusively

I have now given you a general outline of the development of the concrete elevator business and it remains only to state in this connection that concrete, at least for terminal and milling elevator construction, has now almost entirely displaced not only wood, but steel and tile.

The displacement of wood is readily comprehended and is only a portion of the prevailing tendency toward fireproof and permanent construction. The ascendency of concrete over steel and tile arises from the fact that it can be more cheaply constructed and is, as regards steel, rightly considered by the underwriters a considerably better fire risk.

Cupola Construction

In the earlier days of concrete elevator construction, the superstructure above the bins, or what is technically known as the cupola, was built of structural steel with concrete floors and roofs and generally a corrugated steel outside covering. Recently a number of elevators have been built with reinforced concrete cupola. It undoubtedly presents a better fire risk than the steel and a lower cost of maintenance. The question as to whether or not it can be built as economically and quickly as a structural steel cupola is one on which there is still room for argument. The cupola of a terminal grain elevator requires a considerably more complicated form of construction than the ordinary reinforced concrete warehouse building. The most prominent example of concrete cupola construction is at the new Montreal Harbor Commissioners elevator, and this cupola, whether in comparison with elevator construction or with any other form of reinforced concrete building, is an instructive example of what can be done with concrete. Not only are the columns, girders, beams, floors and roofs of concrete, but the curtain walls and even the elevator leg casings 2" thick are of this material.

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*Presented before the National Association of Cement Users, Pittsburgh.

†Vice. Pres. John S. Metcalf Co., Montreal, P. Q.

Wall Forms

There is nothing in connection with the construction of foundations and first story of a concrete grain elevator, and very little in the construction of the cupola, calling for special comment as to method of procedure. Aside from the fact that foundation loads are exceedingly heavy, and the item of the complicated construction sometimes necessary in the cupola, as already mentioned, the ordinary methods of concrete warehouse construction are in general followed in building such portions of grain elevators. The construction of the bin walls has, however, developed a method of construction not used, so far as I am aware, in connection with other buildings. This arises from the great height of bin wall of the same thickness, which early suggested that a short form which could be moved up continuously would be the most economical means to be used.

The earliest concrete bins, those at South Chicago, Minneapolis, Duluth and Indianapolis, above referred to, were built by means of fixed or shutter forms. So far as I can learn, the first set of bins on which the moving bin form was used was the cluster of nine cylindrical bins built for the Canadian Pacific Ry. at Port Arthur, Ont., in the latter part of 1903.

All moving bin forms have certain characteristics in common, the variations between those used by different contractors, or by the same contractor at different times and on different work, being more in method than in principle. The form consists of horizontal framing pieces to which vertical sheeting is attached. The form may vary in height from 3′ 0″ to perhaps as much as 5′ 0″, measuring by the length of the vertical sheeting, but is always a comparatively short form. It must, of course, extend along both sides of each wall, the forms on the two sides of the wall being connected by vertical timber or steel yokes which are usually attached to the horizontal framing of the form. The sheeting is generally of wood dressed on the side in contact with the concrete. Galvanized sheet steel on a wood framework has also been used and in some cases the wood sheeting itself has been covered with steel, either only on the forms for the outside walls exposed to view, or on the forms throughout the work. The purpose of covering the wood sheeting or lagging with sheet steel has been to make smoother walls, which would thus have a more presentable appearance and would also require less pointing up or patching. It has been found that the use of steel is not necessary if the raising of the form is carried on rapidly and continuously and a gang of pointers follows closely after the moving forms. In such cases the wooden sheeting has produced workmanship which is all that can be desired and in some ways is superior to that produced by stationary forms.

Moving Forms: The principal difference in methods of building bin walls with moving forms is dependent upon the procedure followed for raising the forms. It is necessary, in order to obtain walls which are smooth and results which are economical, that the forms be raised continuously and that the movement be at a steady rate. The concrete at any particular point must have a reasonable length of time to harden before the bottom edge of the sheeting gets above it. This means that the progress in any one day is limited to a maximum of approximately twice the depth of the form, which insures that there will never be any exposed concrete which is less than 12 hours old. Assuming a 4-ft. form, this means that the movement must not exceed 4′ 0″ in 12 hours and it is generally less than that; so that a very slow, but at the same time a very steady, upward movement is desirable It will probably be asked, why not build forms with longer sheeting and jack faster ? The answers are, first, that it is not desirable to put a much greater load on green concrete; and, second, that 6′ to 8′ of concrete a day on a large building has been found to be the maximum which can be gotten into the forms, when the placing of reinforcing and other items tending to delay have been considered.

The Canadian Pacific elevator at Port Arthur, built in 1903, was, as stated above, the first elevator, so far as I am aware, on which moving bin forms were used. The jacking was done by means of, I think, ordinary locomotive jackscrews. Brackets were fastened to the lower horizontal members of the forms and the jacks were set on vertical posts with the top of the jacks bearing against these brackets. As the forms were raised to the limit of each jack, another section of post was added below the jack and the entire form structure thus gradually raised from bottom to top by increasing the length of the post. The jack posts were probably of varying length, so that all jacks would not have to be released simultaneously.

Another method of raising moving forms, and that used by our company at the Missouri Pacific Elevator, Kansas City, and on one or two other contracts, was somewhat similar except that the jack was placed at the bottom of the bin instead of at the top next to the form. Locomotive jackscrews were placed below the posts and the entire form structure and scaffolding gradually raised, the new sections of post being put in at the bottom from time to time as the limit of travel of any jack was reached.

Jack Equipment: After this time, with the increased number of concrete elevators being constructed and the increased number of engineers working on schemes for raising the forms, the method of jacking becomes more diversified. The style of jacks may, however, be divided into two general classes, the screw jack and the pump jack. The former depends on the travel of a nut on some form of threaded rod, either in the jack or in the bin wall; the latter depends on a toggle arrangement operated by a lever with pump handle motion and working on a plain rod. Practically all builders now support the forms, not on a scaffolding between the bottom of the bin and the form, but on steel rods which are embedded in the bin wall. The jack travels upward on these rods, the jack itself generally being attached to the yoke, to the lower end of which the bin forms on either side of the wall are secured.

The question as to whether the pump jack or the screw jack is the better style is one on which experts disagree. Some who have used both kinds are very much in favor of the pump jack; others who have had experience with both kinds stick to the screw jack. We have experimented with the pump style, but have never seen fit to adopt it in actual construction work. We have used two or three different styles of screw jacks and have built about 10,000,000 bushels capacity of storage bins with the jack we are now using. In this case the vertical rod which is embedded in the wall, and on which the jack operates, is threaded the entire length with a double "V" thread about 3½ pitch. The jack casting is attached to the yoke and consists of one supporting casting and a revolving casting with apertures for the jack levers. The revolving casting is set over a square nut on the threaded jack rod. As the revolving casting is turned the nut climbs the jack rod and the yoke and forms are raised. This jack enbles us to make steady progress, is capable of exerting great power in case of the forms sticking, and is sufficiently fast. On two different sections of the Montreal Harbor Commissioners' elevator, each section being about 150 ft. by 100 ft. in plan, we have run up 86′ of bin walls in less than 14 days, or better than 6′ per day. This is, of course, working night and day; for if a moving form is stopped after it is once started a joint in the work is sure to show, and generally a small offset or shelf is left at the joint.

One company uses another type of screw jack; in its case the vertical rod in the wall is a plain rod. The jack is, briefly, an extra heavy pipe about 2 ft. long and threaded on the outside. The jack rod runs through this pipe, which is provided with a clutch at the lower end. The traveling nut operates on the pipe and when the limit of travel has been reached the clutch is released, the threaded pipe run to the other end of the travel and the operation repeated. They have secured good results with this jack. The Macdonald Engineering Co., Chicago, on the other hand, after trying various styles of jacks, has abandoned screw jacks altogether and uses a pump jack only. Another contractor has used both, of various styles, but of late has leaned to the pump jack.

From what I have said in regard to the speed at which bin walls can be built, it may be thought that there are no troubles in this business, but I can assure you that every builder of concrete elevators who has used moving bin forms has also had his griefs. Even when the forms themselves are practically perfect, there are other considerations which sometimes cause trouble. It is not possible to build a very thin wall with a moving form, the determining factor being the relation between the weight of concrete in the form and the friction of the concrete against the sides of the form. The area of form exposed to the concrete is the same no matter what the thickness of the wall, while the weight, of course, varies in direct proportion to the thickness. I think it is entirely practicable to build a 6-in wall with moving forms but that it is dangerous to go much below this unless very special precautions are taken to prevent lifting of the concrete. We have built concrete elevator legs 2" thick with moving forms with good results, but in that case we lifted the forms with chain blocks and went with comparative slowness.

Cements Used: The rate of progress of which I have spoken is possible only with a comparatively quick-setting cement such as is used in the United States and Canada. The standard British cement sets very slowly and the use of moving forms is unknown in Great Britain. Thus far, as the British engineers are slow to allow innovation, they have not been willing to permit the use of a quick-setting cement and a moving form.

The speed of the work and the freedom from trouble will depend, it would seem in some cases, on the cement. Three elevator builders have had trouble with one particular brand of cement in moving forms and decline to use it further A fourth has used it with success and is not afraid of it. Whether the trouble arises from this particular cement having properties which cause it to stick to the forms more than other cements or whether it sets before the forms have been moved and thus causes the top of the wall to break away from the portion below it, is a question no one, not even the cement people themselves, have been able to answer satisfactorily

Aggregates: The question of aggregates seems to be a comparatively unimportant one. We have had good results with crushed stone concrete and with gravel concrete. The crushed stone concrete has, perhaps, less tendency to lift in the forms, but on the other hand, on account of the likelihood of sharp corners of the stones catching in the wood of the sheeting when tamped and thus being displaced as the form is raised, smoother walls are generally obtained with gravel concrete. We have successfully run bin walls with sand and cement alone, though in general we should consider this taking a chance because of the tendency of a cement mortar to stick to forms.

Three-Story Tenement Built of Concrete With Wall Machines

The accompanying illustrations show a 3-story tenement, 36' x 60', which is being built for Richard Kleemichen, 53 Henry Street, Stamford, Conn., by the New England Concrete Construction Co. Four Van Guilder wall machines* are being used, two 5-ft. machines and two 2-ft. machines, with plaster and chimney attachments.

The outside wall is 4" thick, the inside one is 6". Steel rods, ¼" in diameter, are used as reinforcement, both laterally and transversely. The mixture is 1:2:4, and used quite wet, so that the water shows when machine is removed. There is no waiting for the walls to set; the operators keep right on with the machine around the building. In good drying weather, 4 courses are laid per day, but the average run is about 3 courses. When the walls are set they are hard, and, the contractors say, ring when struck with a hammer.

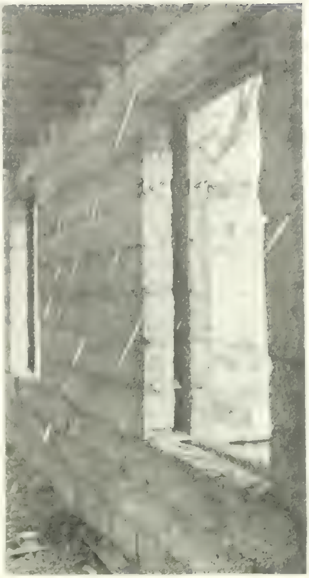

FIG. 2—INTERIOR DETAIL SHOWING DOUBLE-WALL CONSTRUCTION

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*Van Guilder Hollow Wall Co.

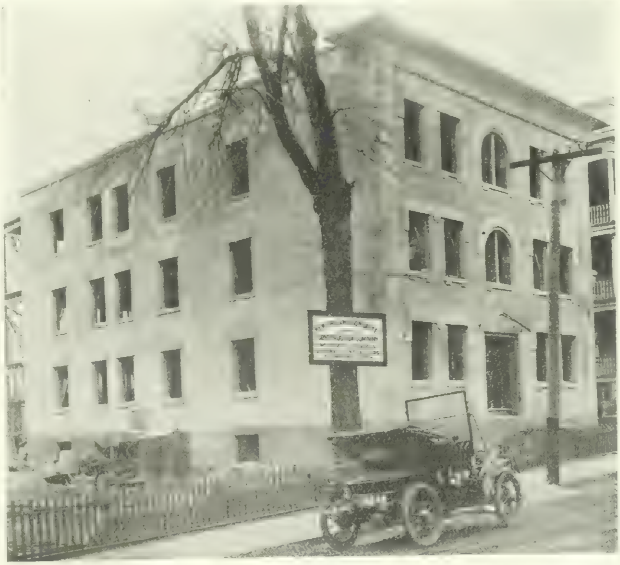

FIG. 1—DOUBLE REINFORCED CONCRETE WALLS IN THE CONSTRUCTION OF A 3-STORY APARTMENT HOUSE

The pilasters, lintels and cornice were all cast in place with special equipment

In the construction of the building, it was decided after reaching the second story to set up the window frames and work right up to them by tacking a temporary strip on the frame, making it the width of the wall. This is to some extent usual practice in running monolithic wall work. In this way the frame with the strip on either side acts as a spreader for the wall centering, which can be wired or bolted tightly to the frame.

[Editorial Note—In ordering frames for monolithic wall work it is customary on some work to have the mill send the frames with strips toenailed on either side bringing them out to the full width of the wall. This can be done at the wood-working mill at a slight additional cost which is more than saved in the operation of the work. Before placing the frames in the forms the outside should be creosoted or tarred in some way, and a strip should be nailed around the outside to tie it into the concrete wall. The frame should also have plenty of interior bracing to keep it from bulging inward under the weight of the concrete.]

The walls of this building from cellar to roof-plate were completed in 30 days. A Eureka mixer* was used.

National Association of Cement Users

(Continued from page 5)

Chicago, who presented to the Association at its 1910 meeting the first paper on "life-size" building tests, described some tests recently completed on a flat slab building. This structure was designed according to data from previous building research tests, and the work described was in a way a check test. Mr. Lord talked informally from stereopticon views. One item of interest was the surprising statement that under a load of 618 lbs. per sq. ft. a floor showed a retrogression in deflection, or recovered somewhat after 44 hours' loading. Another paper on at slabs was presented by T. L. Condron. Rectangularly reinforced flat or paneled floor systems was used in the work described. A mathematical analysis of the rectangular reinforcement was included in the paper, and the discussion following was of much interest. The paper concluded with an excellent series of slides showing work recently completed.

Rigid Frame Construction

Sanford E. Thompson submitted to the convention an entirely new field of investigation in describing a rigid-frame solution for bending moment formulas. The paper will be found to be discussed more in detail elsewhere in this or in an early issue.

Stress Distribution in Wide Beams

W. A. Slater, asst. prof. Univ. of Illinois, Urbana, Ill., described an interesting series of experiments conducted to investigate the lateral distribution of load in wide slabs. If a road-roller rested on one roll in the center of a box culvert cover, how would the stresses be carried to the walls? Special equipment to develop concentrated load was used. The paper appears in abstract elsewhere.

Testing Methods

The report of the committee on specifications and methods of tests was submitted by Sanford E. Thompson, chairman, at the Friday morning session. Throughout the past year the committee has done considerable work investigating and advising as to testing methods in many laboratories, compiling test method data and collecting results for presentation. The report covered the work in full, and will be referred to letter ballot.

Aggregates

The committee on aggregates, through its chairman, Wm. Kinney, Pittsburgh, reported its progress for the past year. The report was accepted and will be referred to letter ballot.

Microscopic Analysis of Cement

The Bureau of Standards is doing admirable research work in microscopic analysis of cements. The paper on this subject by P. H. Bates, of the Bureau, described this work in a most interesting way.

Concrete Products in Germany

Methods of manufacturing concrete products have been developed to a high degree in Germany, and an interesting account of work done, and methods used, was presented by Julius Carstanjen, of the Duisberger Zement-Waaren Fabrik, Duisberg, Germany. Methods of repairing stone masonry were described in detail, and the discussion following brought out interesting points wherein German and American practice differ. In many phases of the work, however, the methods are very similar.

Architectural Concrete

The surface texture and coloring of concrete products is a most fascinating subject, and an exceedingly interesting paper on this subject appearing elsewhere in this issue was presented at the Friday afternoon session by Adolph Schilling, Philadelphia. The stereopticon views were good, and on a table in the convention hall were exhibited specimens of architectural concrete which excited interest and admiration.

Work of the Bureau of Standards

It has been pointed out several times that the work of investigating structural materials, their physical, fire-resisting properties, and so on, should be conducted by, or under the direction of, the national government. To a very great extent, this is now being done by the Bureau of Standards and the publications of this Bureau are meeting a real need in the engineering literature and data of the day. In an interesting paper, the last one presented to this convention, the work of the bureau in investigating and standardizing cement, concrete, and concrete materials was described by Rudolph J. Wig, of the Bureau of Standards, Washington.

The paper by E. S. Fowler, Chicago, on concrete silos, was read by title only, as the convention came to a prompt close at 5 o'clock Friday afternoon to permit the same hall being used for the annual banquet.

The Banquet

With the strain of the three days' convention over, Friday evening was given over completely to the goodfellowship and cheer of the annual banquet. The singing was well directed, the menu attractive, and the speeches entertaining.

Visit to the Bureau of Standards

The Pittsburgh station of the Bureau of Standards, quartered in the old Alleghany arsenal, was visited Saturday morning by a large number of Association members. The principal object of the visit was to witness the test on a column reinforced transversely with flat spirals. This was tested to destruction in the 10,000,000-lb. testing machine with very satisfactory results, described in detail elsewhere in this issue.

An interesting feature of the visit was the demonstration of safety explosives for mines. The entire testing station offered much of interest and value to the visitors.

Conventions of the National Association are a great factor in the development of better methods of concrete construction. Members come from far and wide, and on the platform and floor of the convention bring to the attention of all the members, and of the concrete engineering world, the best practice and experience that each individual has worked out, and as the convention comes to a close, the active, intimate practical work of the Association is carried into field and office and shop all over the country. For the country at large it means better concrete, and more of it.

At the recent convention of the National Association of Cement Users, one speaker described the use of lamp-black in concrete to eliminate the clayey cream color when that was disagreeable. According to the speaker a small proportion of lamp-black acted like bluing, producing a white concrete.

It is sometimes desirable to handle concrete floor top finish very wet. As everybody knows, when this is done the surface is very apt to show trowel marks. It is very easy and is usual practice by many contractors to rub out these trowel marks with carborundum stone after the floor has hardened and use soap or linseed oil to make a hard and dustless surface.

The Baldwin Locomotive Co., Philadelphia, has a squadron of 10 Sauer* trucks which are used chiefly in hauling raw material for locomotives between the shops of the company. These trucks displace 20 double teams at a saving it is said of 33⅓%.

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*Eureka Machine Co.

*International Motor Truck Co.

Concrete Organizations, Officials and Conventions

National Association of Cement Users, Edward E. Krauss, Secretary, Harrison Building, Philadelphia, Pa.

Association of American Portland Cement Manufacturers, Percy H. Wilson, Secretary, Land Title Building, Philadelphia, Pa.

American Highway Association, J. E. Pennybacker, Jr., Secretary, Colorado Building, Washington, D. C.

Northwestern Cement Products Association, J. C. VanDoorn, Secretary, Security Bank Bldg., Minneapolis, Minn.

Cement Products Exhibition Co., 72 West Adams St., Chicago, Ill.; Secy.-Treas., J. U. C. McDaniel, 108 La Salle St., Chicago, Ill.

Chicago Cement Show, Coliseum, Jan. 16-23, 1913.

Nebraska Cement Users' Association, Secy. Treas., Frank Whipperman, Omaha, Neb., convention Feb. 5, 6 and 7, and show Feb. 4 to 8 inclusive, Auditorium, Omaha.

Iowa Association of Cement Users, Henry H. Dean, Glenwood, Ia., Secretary; annual meeting Jan. 7 to 9 inclusive at Mason City.

Canadian Cement and Concrete Association, William Smith, Secretary, 57 East Adelaide St., Toronto, Ont.

At the forty-sixth annual convention of the American Institute of Architects, December, 1912, the election of officers resulted as follows: President, Walter Cook, New York; 1st vice-president, R. Clipston Sturgis, Boston; 2nd vice-president, Frank C. Baldwin, Fredericksburg, Va.; Secretary and Treasurer, Glenn Brown, Washington, D. C., all re-elected. Directors elected for three years are: Burt L. Fenner, C. Grant LaFarge and H. Van Buren Magonigle, all of New York.

Winter Work In Products Plants

(Continued from page 10)

lieve that with stone dust I can use one quarter less cement and get better results than with sand.

BY A. G. HIGGINS[10]

Our concrete business slows up in cold weather on account of building slowing up generally. We do all our work in the shop and keep the temperature above freezing; have used steam curing a little in a crude way, but are not sure that it is of enough advantage to warrant installing the proper plant to take care of it. We have mostly inside storage and practically no trouble from freezing into cakes. Really have nothing of benefit to others.[11].

BY A. E. CLINE[12]

Up here with our severe winter weather ranging as low as 48° below zero there is very little building done is very little building done in the months in the months of December, January or February. Formerly, we closed down during these months, but last winter, which was a very severe one, we did not miss a day (owing to weather) and had a crew of about 40 men making hollow tile, sewer pipe and ornamental stone. We started making block early in March, and we never had a product damaged by frost.

To begin with, our plant is warmly built of hollow tile and block, and is warmed by a steam coil and fan system[13]. Our sand and gravel arrive in cars, always frozen; this was wheeled into bins 16′ sq. On the bottom of each bin are two ½-in perforated steam pipes. After unloading a car the steam is turned on and in a few hours all frost was gone from the sand.

For the protection of the plant and men, we use a canvas between the car and the doorway, made in form of a tunnel, thus making the car a part of the plant, for the time being

All our products are steam cured, and are kept in the kilns from three to seven days. The kilns are allowed to cool before the product is taken out, but even though wet when put out into a temperature of 46° below zero, we have never seen any bad result from it..

Book Review

Concrete Highways. Published by the Association of American Portland Cement Manufacturers, Philadelphia. Pages 95. Size 6 x 9. Illustrated. For Free Distribution.

"Concrete Highways" will interest road supervisors, contractors and taxpayers in every section of the country. The book is well illustrated; it was prepared by expert road engineers and goes into every detail of construction, concluding with a tabular digest of concrete pavements in many sections of the country. The various chapters include discussion of bituminous compound wearing surfaces, grouted pavements, reinforced concrete pavements and specifications for the 1- and 2-course types. In fact, the book covers the subject in a reliable and authentic way. Road supervisors, especially, will find it of inestimable value and the taxpayer will be extremely interested in the economical results obtained by the introduction of these durable concrete highways. Copies of the book may be had upon application to the Association of American Portland Cement Manufacturers, Land Title Building, Philadelphia, Pa.

For a quarter of a century, the general offices and Chicago laboratories of Robert W. Hunt & Co. have been in the Rookery. Owing to inability to secure in that building the necessary space, they moved, Dec. 1. to the Exchange building, Jackson Blvd.

The Pittsburgh Cement Show and Its Influence

The first Pittsburgh cement show was held in Exposition Hall, Pittsburgh, December 12 to 18. The degree of the success of the show and its extent of influence depend very much upon the point of view. To some of us, who in past years have seen cement shows in a blaze of glory, filled every day with interested and often open-mouthed people, the Pittsburgh cement show seemed to be unappreciated and not well attended and to some extent a failure.

Two points must be taken into account. In the first place, as a well-known Pittsburgh supply man explains it, the wave of concrete as it moved eastward passed over Pittsburgh and that city has only begun within the past few years to use this material to any extent. Accordingly, concrete has not been, so far, a very big factor in Pittsburgh's developments. This means, that while the show may not have been so successful as some of the other shows in the past, yet it was needed, and its effect will be far reaching in future developments. Returns coming in since the show indicate that to a great, and in a certain way to an unexpected, extent the show was successful in reaching many possible users of cement, and reaching them in a very effective way.

Another reason why this show did not apparently come up to those in the past, is the fact that concrete is becoming an established material, it is becoming the general, the ordinary construction material, and people turn out in great numbers to see the extraordinary only. Consequently, while the Pittsburgh cement show was not so impressive in numbers, it seems that almost everybody who went there went to secure really definite information on some new use of concrete or some equipment.

The exhibits were as a rule well selected and well prepared. The great number of concrete machinery exhibits so in evidence in past shows was absent and their places taken by wonderful educational exhibits of big institutions. First among these, must be mentioned the exhibit of the United States Bureau of Standards. This bureau is doing great work in testing and standardizing various materials and the engineers of the Bureau have contributed considerable data of the greatest value to cement and concrete research work. The exhibit of the Bureau of Standards shows in detail the very delicate apparatus used in determining the physical properties of cement and concrete. A center of interest was the "interferometer," by which could be determined the deflection of a short concrete beam to 1/1,000,000 of an inch. The exhibit was arranged so that everyone was permitted to come up, look in the eye-piece, press on the beam and see it deflect. It caused much interest and wonder. Another exhibit was the actual demonstration of the varying fineness of cement; test tubes on exhibition, showed in actual proportion the cement which had passed various sieves. Pyrometers and many other pieces of delicate apparatus were shown.

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[10] Trusswall Mfg. Co., Kansas City, Mo.

[11] This company does architectural work, making Trusswall columns, etc., which makes the factory conditions rather different from those in block or tile plant.—EDITORS.

[12] Supt.. Perfection Concrete Co., Ltd., Winnipeg, Man.

[13] Installed by the Buffalo Forge Co.

The University of Pittsburgh also had a most interesting exhibit of its laboratory work in testing concrete materials and reinforced concrete. Testing apparatus was shown in detail.

Mixers have shown some development throughout 1912. The large machines have been improved in details making for smoother and more economical operation. Other mixers have been developed to take care of smaller work more conveniently. Probably the most important point in mixer power development has been the use of direct engine drive to the drum of the mixer. Machines embodying these points were on exhibition.

Steel forms were well represented and were a center of much attention. There were not so many cement companies as at past shows, but the exhibits there were excellent. One booth was given over entirely to architectural products, with the most artistic results. Much of their space was devoted by the cement companies to exhibiting the most improved ways of handling cement, the advantages of conveying cement in bulk, how to handle bags, and so on.

Two very interesting exhibits were the machines used to tie cement sacks with wire. These were in operation a good deal of the time, and their ingenuity and rapidity excited much comment.

Sidewalk forms have brought out several new developments within the past year, to make for better and more economical work. Concrete for fence posts is now the standard material adopted not only by railroads and farmers, but coming into almost every conceivable place where fence posts are used. The fence post machines on exhibition attracted much attention.

Crushing equipment for producing concrete aggregate were in continuous operation and a center of interest. There have been some developments and improvements in this field in the past year and small crushers are coming more and more into use by contractors who want to produce their own aggregate.

Any user of concrete, builder or engineer, found in the show much of interest and value. New methods of building hollow walls, new methods of waterproofing, new silo construction equipment were in evidence, and at every point could be seen factors of the year's development which make for better and more economical work.

The field of concrete construction is broadening out into the general construction of better hygienic and fireproof buildings, and a good deal of the exhibit space was given over to other exhibits. These, while not demonstrating structural concrete, are a necessary auxiliary in making for this better construction. Among these may be noted steel sash, artificial marble materials, various asbestos products, and many other things making for better building.

All in all, the Pittsburgh cement show was a success. Concrete engineers and builders are settling down in an earnest endeavor to get out of their material the utmost in it, and at every exhibit nearly every hour of the day there were crowds of information-seeking workers in concrete. So long as a cement show reaches these men, and reaches them successfully in any numbers, it is a success.

Concrete Block Walls of School Resist Fire Attack

A fire hot enough completely to destroy everything burnable in a school house in the town of Penfield, near Rochester, N. Y., is reported to have caused no serious damage whatever to the concrete block of which the walls were built. The accompanying illustrations show the building as it appeared very soon after erected (Fig. 1) and after the fire had burned out (Fig 2). With a fire hot enough to take out practically every vestige of the interior it is said that not even the granite facing of the concrete block spalled, though a marked line of weakness is generally supposed to exist between the two mixtures in a block. The first picture was reproduced in *Concrete*, October, 1911. The building was designed by Architects Fay and Dryer, Rochester, and the concrete block were made by J. Frank Norris on Hercules[1] machines.

The building cost $15,000. The crack to be seen under a window in Fig. 2 was there before the fire, having been caused by a settlement of the wall. Of course the point of the whole matter is that the floors, stairways and so on also should have been built of concrete. Even though all these block can be used again in another building, as it is understood they will be, why continue with a half measure when the same material can be used for all the work?

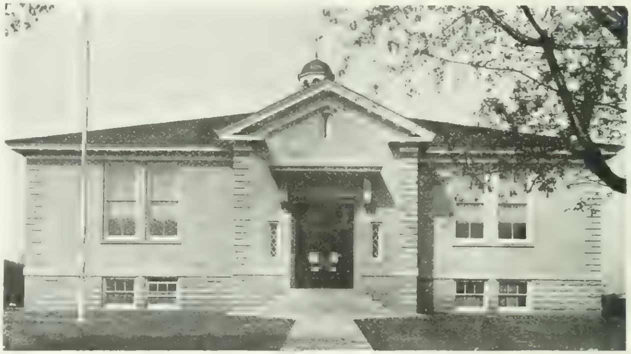

Fig. 1.—Concrete Block School House Before Fire

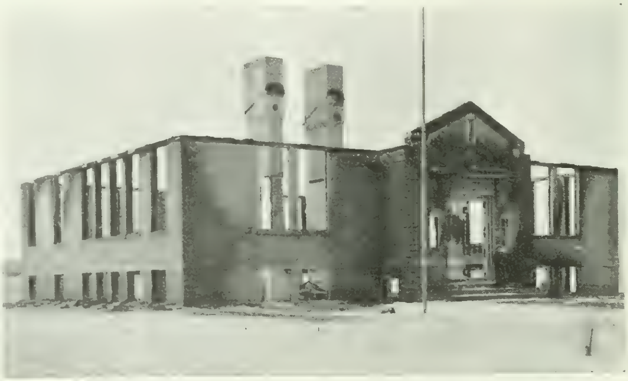

Fig. 2.—After the Fire—Moral, Use Concrete Inside the Building, Too

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"How a Revolvator Saves Time, Money and Space." Bulletin No. 11. New York Revolving Portable Elevator Co., Jersey City, N. J. 6" x 3", paper bound, 13 pp. Illustrated.

Mesta Machinery. Brief description and illustrations of the plant and product of the Mesta Machine Co., Pittsburgh. 7¼" x 5¼", paper bound, 47 pp. Illustrated.

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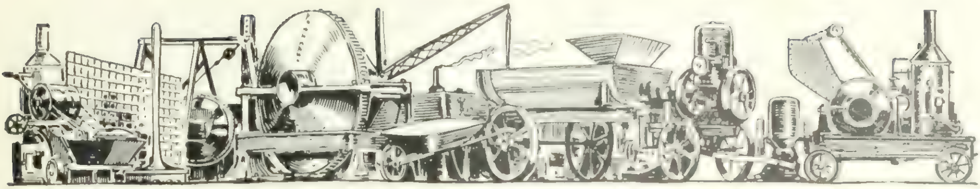
[1] Century Cement Machinery Co.



New Equipment, Methods and Materials

In this department the EDITORS endeavor to keep our subscribers informed upon new tools, methods, machines and materials used in this industry. It is in no sense a department for the benefit of advertisers. To secure attention the thing described must be new to our readers. No matter will be printed simply because an advertiser desires it. Likewise, no matter will be excluded simply because the article described is not advertised in this paper. We aim to keep our readers informed—suggestions for the improvement of this department are solicited.

Permanent Roof Construction

Permanent fireproof roofs at minimum cost have long been a thing sought in building construction. Corrugated steel sheathing, covered with concrete, has been widely utilized for roofs, and the material used in the following tests, developed by the Asbestos Protected Metal Co., Beaver Falls, Pa., is flat corrugated steel sheathing coated with natural asphalt, which is, in turn, protected by rock-fiber asbestos felt. For roof construction, this asphalt-asbestos surface protects the steel and presents a finished under surface, eliminating the necessity of plastering.

Some tests were recently conducted by the company at its plant in Beaver Falls, Pa., to determine the deflection of slabs under different loadings, and to observe the manner of failure.

The Tests

The frames upon which the slabs were tested were constructed of 2"x8" timbers as shown in Fig. 1. The supports on which the slabs were placed were 2"x8" purlins, spaced 4' on centers. The steel sheets were 8' in length and extended 2' beyond the center of the supports, the ends of the sheets resting on and being fastened to 2"x8" purlins shown in the sketch. The steel sheets in all cases were 8' long with a laying width of 24". They were of 24-gauge for slab "A" and 26-gauge for slabs "B," "C" and "D." Sheets were nailed to the purlins with one 2" nail in the bottom of every other corrugation. The side lap of the two sheets forming the base of each slab was bolted in the center with a ⅜" bolt which extended up above the surface of the concrete a distance of ½" and was used as a point from which deflections were measured.

Concrete Slab: The concrete slab was composed of 1 part Portland cement and 2 parts clean, sharp sand, thoroughly mixed and applied wet. The distance from the bottom of the corrugation to the top of the concrete was 1½" for slabs "A" and "B" and 1¼" for slabs "C" and "D." (See Fig. 2.) In the case of slab "D," 1⅛-in. x 3/16-in. bolts were fastened in the bottom corrugations of the sheets, the ends of these bolts being within ¼" of the top of the finished surface of the concrete. Seven bolts were placed in every other corrugation, spaced about evenly in the central 30" of the span. The object of this was to determine if possible whether or not the anchoring of the "Asbestosteel" sheets to the concrete would add materially to the strength of the slab.

Measuring Deflection: Deflection was measured by means of apparatus shown in Fig. 1. This consisted of a light wooden frame in which the top piece "A" was slotted to receive the upright rod "B," which was free to move through the slot in "A," and it carried the steel scale "C" graduated to 1/32". The rod "B" had a ½-in. hole ¼" deep in one end to set on the ⅜" bolt in center of concrete slab. Deflections were measured by taking readings of the steel scale at the under side of the top piece "A."

Loading: The loaded portion was 4' 0" from center to center of supports and 4' 0" wide, the load area being 16 sq. ft.

A light wooden frame, 4'x4', inside measurements, was placed on a slab and 640 lbs. of sand spread evenly over the surface inside. A reading was taken to obtain a deflection for this loading and the slab was then loaded with pig iron piled on top of the sand, and deflection readings taken at each additional load at approximately 600 lbs. The sand was weighed on a platform scale adjacent to the slabs. To determine the weight of the load, each "pig" of iron had been previously weighed and its weight painted directly on the surface. In loading, the weight of each pig was called out by the man placing it, and recorded in duplicate by the engineers in charge of the test.

Results: Slab "A" under a load of 125 lbs. per sq. ft. showed a deflection of 5/32" and longitudinal cracks appeared in the center of the slab, following the line of the lap in the steel sheets. Under a load of 265 lbs. per sq. ft. there was a deflection of 10/32" and slight cracks appeared at the haunch. At this point the measuring apparatus had to be removed owing to the height of the piles of pig iron. The loading was continued until a load of 382 lbs. per sq. ft. had been applied and the deflection, roughly measured, was ½". The load was removed and the slab returned to practically its normal position, showing a permanent deflection of approximately

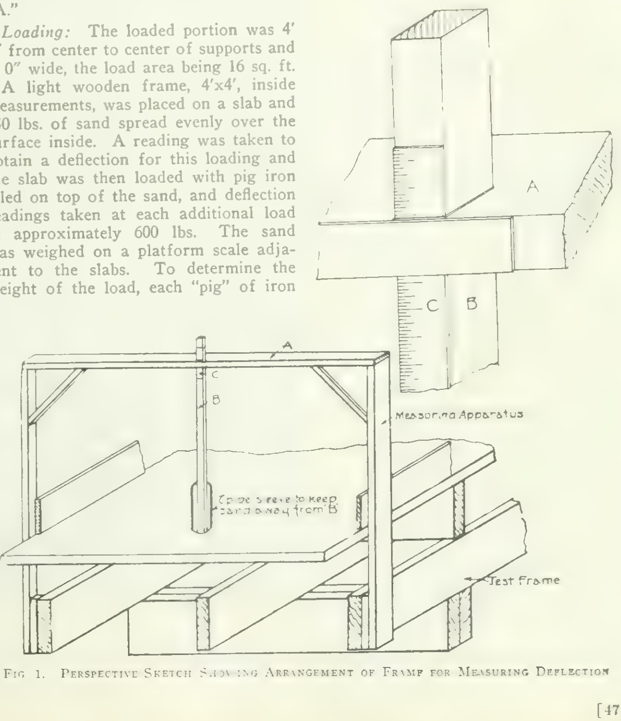
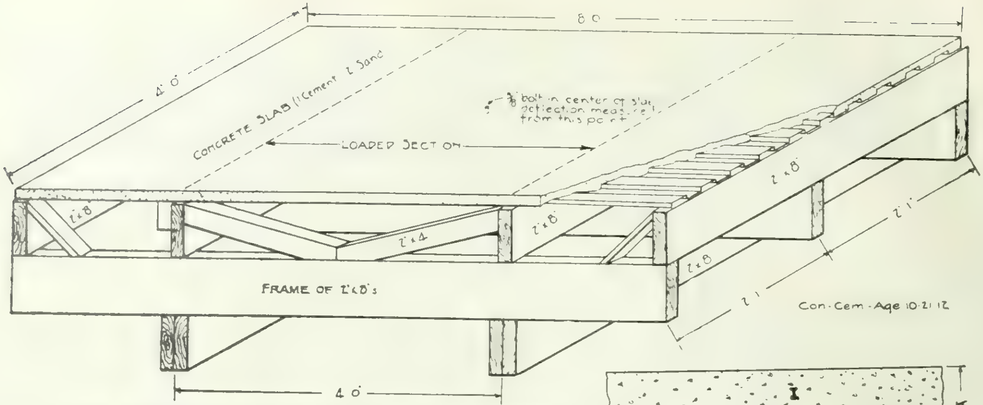
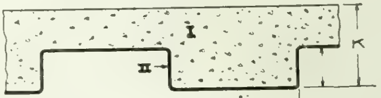


FIG. 1. PERSPECTIVE SKETCH SHOWING ARRANGEMENT OF FRAME FOR MEASURING DEFLECTION


8' 0"
4' 0"
CONCRETE SLAB (1 Cement 2 Sand
LOADED SECTION
⅜ bolt in center of slab deflection measured from this point
2x8
2x4
2x8
2x8
2x8
2' 1"
2' 1"
FRAME OF 2x8's
4' 0"
Con-Cem-Age 10-21-12



SECTION OF SLAB
K = 1½" for slabs A & B
K = 1¼" for slabs C & D
I = Concrete (1 cement to 2 sand)
II = "Asbesco-steel" sheet
24 gauge for slab A
26 gauge for slabs B C D

FIG. 2. DETAIL SKETCH SHOWING CONSTRUCTION OF TESTING PLATFORM: DETAIL CROSS-SECTION OF A SLAB SHOWING THE T-BEAM OF CONCRETE.

1/16 in. The only visible cracks in the surface of the slab were those running longitudinally in the center of the sheet.

A week later, slab "A" was re-loaded with sand. The measuring apparatus was removed when a total load of 5,615 lbs., or 351 lbs. per sq. ft., had been applied. Deflection at this point was 21/64". The loading of pig iron was continued, slab being loaded in such a manner as to prevent arching. Slab failed under a total load of 9,810 lbs., or 613 lbs. per sq. ft. The greatest deflection at the failure was approximately 3½ in.

Summary of Tests: The following data sum up the tests on the 4 slabs:

Slab.	Span.	Maximum thickness.	Gauge of steel.	Load in lbs. per sq. ft. at which cracks appeared over supports.	Load, lbs. per sq. ft.
A	4' 0"	1½"	24	265 lbs.	613 lbs.
B	do	1½"	26	226 lbs.	466 lbs.
C	do	1¼"	26	262 lbs.	398 lbs.
D	do	1¼"	26	272 lbs.	381 lbs.

Slab "B" showed a deflection of 7/64" under a load of 130 lbs. per sq. ft., at which point longitudinal cracks appeared in the center of the slab, as in the case of slab "A." At 226 lbs. per sq. ft. there was a deflection of 7/32" and the slab cracked at the haunch. The loading was continued until 466 lbs. per sq. ft. had been applied. At this point the slab failed by buckling in the center.

In the case of slab "C," longitudinal cracks appeared in the center of the slab when the load had reached 190 lbs. per sq. ft. At this point the deflection measured was 14/64". Cracks at the haunch appeared under a load of 262 lbs. per sq. ft., with a deflection of 22/64". The slab failed by buckling at the center under a load of 398 lbs. per sq. ft.

Slab "D," under a load of 272 lbs. per sq. ft., showed a deflection of 13/32", with slight cracks at the haunch.

Under a load of 339 lbs. per sq. ft. there was deflection of 19/32" and longitudinal cracks appeared in the center of the slab. As the slab began to fail there was some apparent arching of the pig-iron load, which was not, however, considered serious. The slab failed by buckling under a load of 381 lbs. per sq. ft.

Error in Settling of Frames: In reading the deflections, no allowance was made for the settling of the frame. This would mean that there was a certain settling which would be incorrectly measured as a deflection and that the final deflections recorded would be high by possibly 1/32 in.

Conclusions

In all cases where failure occurred, the sheet buckled. In buckling, the sides of the corrugations had remained vertical and the top of the corrugation had been pushed in along the line where the buckling occurred. The above tests show, as have other tests with similar materials along the same line, that the strength of the finished slab is the strength in flexure of the corrugated steel plate, *plus* the stiffening effect of the concrete. The vertical web of the corrugations cannot buckle laterally, due to the concrete filler, and consequently offers much greater resistance in bending.

How much the concrete acts in compression with the steel sheathing in ten-

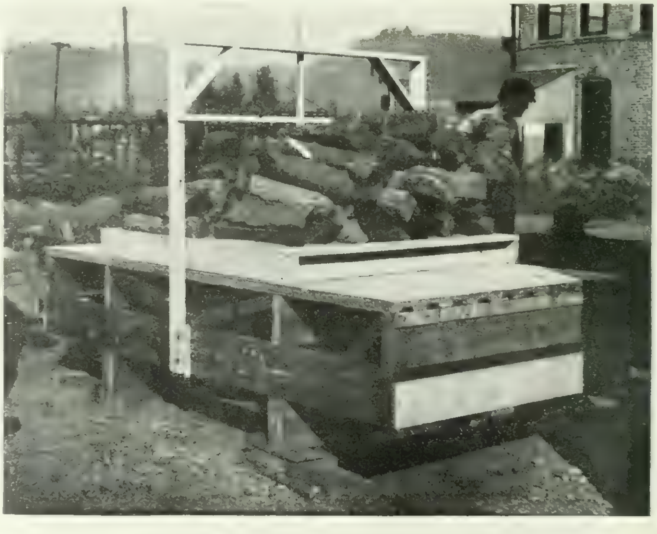


FIG. 3. SLAB "A" UNDER A LOAD OF 235 LBS. PER SQ. FT.
This illustration shows the platform construction in detail; the box frame holding the sand which acts as a bed for the pig-iron; and the scaffold frame used with the vertical rod to indicate deflection (Fig. 1). The end section of the test slab is also plainly shown.

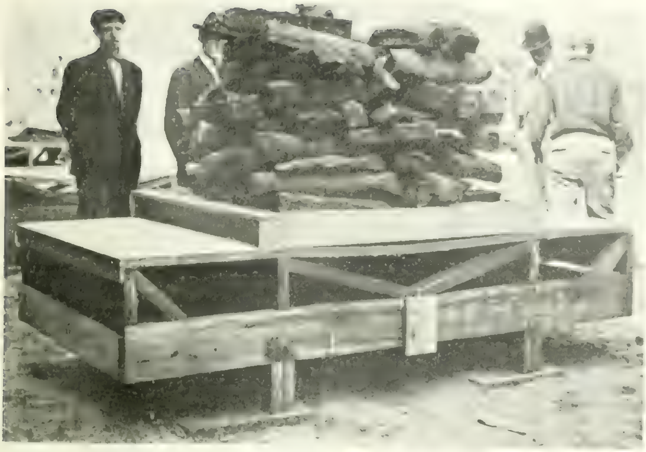


Fig. 4. Slab "C" [illegible]

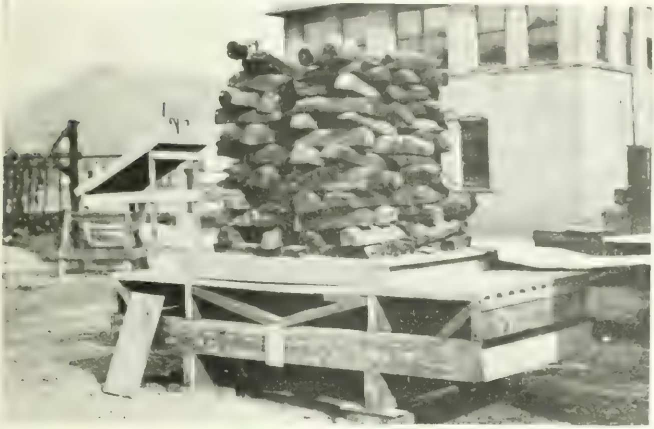


Fig. 5. Slab "A" with a Load of [illegible] Lbs per Sq. Ft. on the Second Loading.

sion is an open question. The position of the axis of compression is also at present undetermined.

The results of these tests seem to show also that, for the amount of metal and quantity of concrete employed, this form of slab shows efficiency and economy. Best results should be obtained by having the concrete thoroughly mixed and applied as wet as is consistent with the pitch of the roof.

A material saving in concrete is effected by this form of construction, as will be indicated by the following:

	Thickness above bottom of corrugation.	Average thickness of concrete.
Slabs "A" and "B"	1½"	1⅛"
Slabs "C" and "D"	1¼"	⅞"

Thus, in the so-called 1½-in. slab, a cubic yard of concrete would cover 288 sq. ft. and in the 1¼-in. slab 370 sq. ft. of surface area.

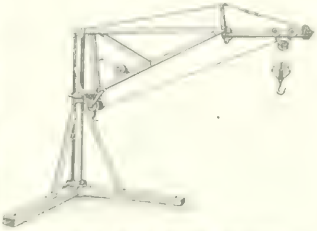
The Steel Sheathing in Tension: In the development of steel sheathing as permanent centering for concrete roofs and floors, a most interesting point is the possible use of the steel sheathing in direct tension. How best can it be made to work in tension with the concrete in compression to resist bending? The bolts set in slab "D" probably assisted in helping the two materials to work together. That the steel sheathing did actually stretch is shown in an examination of the sheets after the test, not only by the fact that the asbestos fiber, at one point, at least, was torn at substantially right angles to the tension, but the following measurements showing the actual elongation of the sheets:

Sheet in Slab "A" Elongated .109"
Sheet in Slab "B" Elongated .229"
Sheet in Slab "C" Elongated .176"
Sheet in Slab "D" Elongated .203"

A possible development of a permanent steel centering, and the use of this steel in tension, is an interesting question. These tests are of interest and value in adding accurate data to our knowledge of the matter, and showing the striking efficiency of such a combination.

A Trolley Extension Hoist

In elevating concrete on small work, it is very often desirable to move it horizontally after it has been hoisted. The accompanying sketch shows a hoist which has been developed by Sasgen Bros. (Chicago), by which the load can be moved on a trolley. So far this hoist has been used more extensively on silo work than anywhere else, but should be of value on any concrete wall work, where it is necessary to spot the bucket as it is dumped. With this trolley equipment, the bucket is hoisted up on either side of the forms, and before being dumped, can be adjusted to any point desired. This trolley should do away with hand pails and swinging in heavy buckets, and should make for better and lower cost work. The derrick is 6′ high with a boom reach of 9′, and is equipped with steel cable.



[illegible]

Sliding Steel Sash

An improvement in the design of solid steel sash is the introduction of sliding ventilators with spring counterbalances. The sliding sash has many advantages over pivoted ventilators,

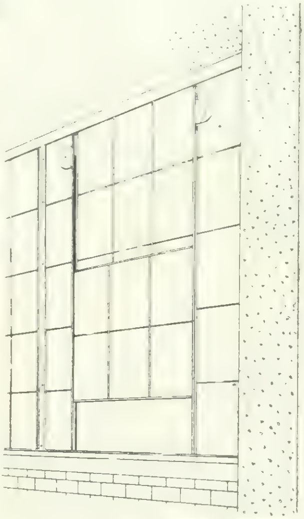


Fig. 2—Detail Sketch Showing Operation of Sliding Sash

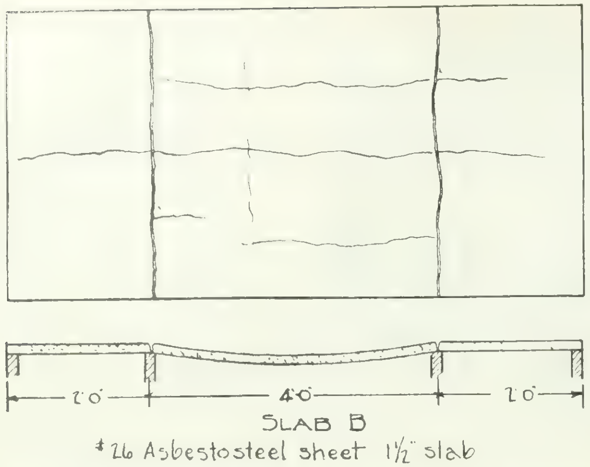


Fig. 6. Plan Showing Cracks in Slab "C" After Removal of Load.
The general arrangement of cracks is typical for slabs "C" and "D." No cracks appeared in slab "A" after the first loading.

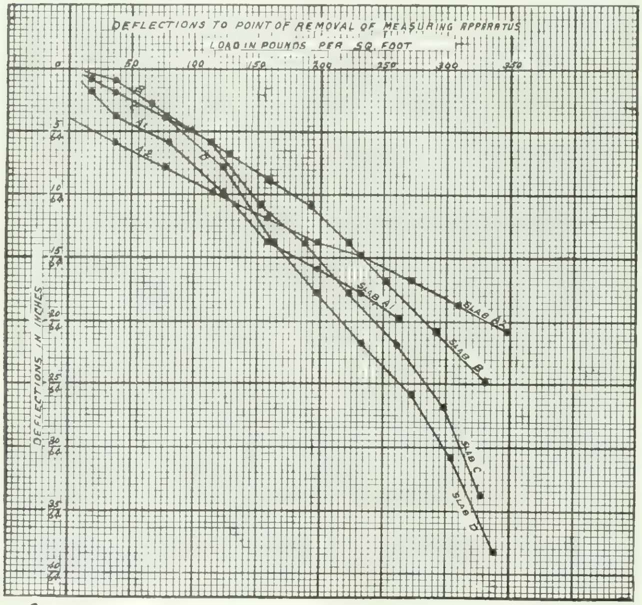


Fig. 7. Curves Showing Deflections of the Four Slabs.

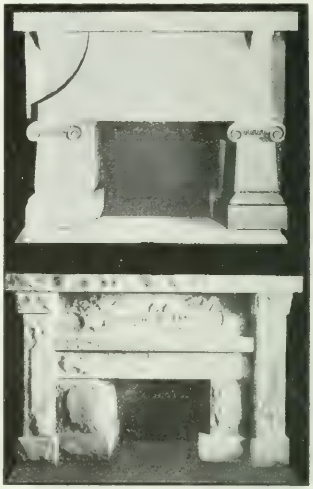
especially where shades or screens are to be attached to the windows. The projecting frames of the pivoted ventilators interfere with the attachment of the shades and screens, also with the location of machinery. Besides they cause accidents by men carelessly striking against them.

The sliding "United Steel" sash developed by the Trussed Concrete Steel Co., Detroit, operates easily in special channels rigidly attached to the steel sash frame. They are counterbalanced by the special coil springs which are noticed in the upper part of the accompanying illustration. Little effort is required to raise or lower the sash.

Another advantage of the sliding sash is the ease in which it can be cleaned, as compared with the sash with pivoted ventilators. Sliding sash provide, it is stated, maximum ventilation and give a particularly attractive and neat appearance to the building.

Concrete Mantel Molds

The field of operation of the concrete products manufacturer is getting bigger all the time in the discovery of possibilities in the use of factory cast concrete units. The Tay-Mac Co., Los Angeles, Cal., manufactures special molds for the production of concrete mantels in many different styles. Two of these styles are shown in the accompanying illustration. The Tay-Mac Co. not only makes the molds and composition plates for the manufacture of the mantels, but also produces the mantels, and in the results which it has obtained special facing mixtures have been used. The mantels are not only produced in different styles and forms, but the company has 12 distinct mixtures used in producing as many different kinds of concrete stone. It is said that light and dark granite effects have been reproduced in concrete with such fidelity that the products on display at the plant have attracted the attention of granite cutters, who have applied to the Tay-Mac Co. for positions in its shop. As a matter of fact, no cutting is done. The entire work is the product of the plates.



Concrete Mantels Colonial Pattern Above; Santa Barbara Mission Below

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Jan. 1, 1913, the well known Universal Crusher Co., Cedar Rapids, Ia., manufacturer and patentee of the original "Velten Universal" crusher, took over the entire sale and control of the line of crushers heretofore manufactured and sold by the Eureka Stone & Ore Crusher Co., Cedar Rapids, Ia. The Universal Co. will continue manufacturing both lines at the Eureka plant. This combination means much to the trade that is interested in small and medium sized crushers and will give customers absolute assurance of being able to buy crushers at medium prices, suitable for all their wants.

[illegible]

Note the [illegible] where the light [illegible]

A New Stucco Trowel

A new tool for the application of rough cast stucco has been devised and patented by John Parkhill, Rochester, Minn. The tool has not yet been placed on the market, but it has been used successfully, according to Mr. Parkhill, on several jobs. Fig. 1 is a reproduction of a photograph of one of the trowels which has been used in placing many hundred square yards of stucco. This is one of several types, all of which are based upon the same principle. The idea is to pick up the stucco in small dabs and to throw it on the wall in small dabs. This particular trowel illustrated has hexagonal openings and the trowels are to be made eventually with openings of various sizes and shapes to pick up stucco in such dabs as are necessary in making a variety of surfaces. It is claimed for the new tool that workmen inexperienced in its use can cover walls very rapidly and evenly. Fig. 2 is a reproduction of a photograph of about 10 sq. ft. of stucco surface done with the new trowel, and Fig. 3 shows a church which has been given a coat of stucco with this trowel. The work on the church mentioned was done at the rate of 27 to 28 yards an hour by a man who had no previous experience with the tool.

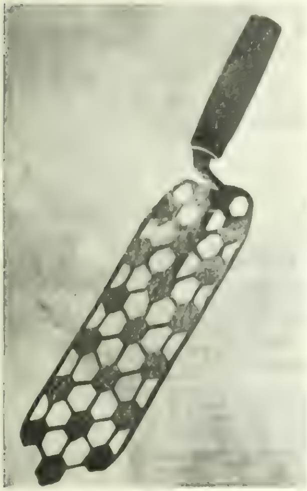


Fig. 1—New Stucco Trowel

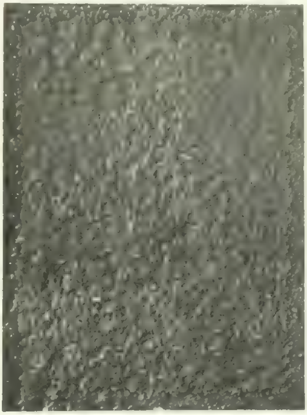


Fig. 2—Stucco Applied With New Trowel

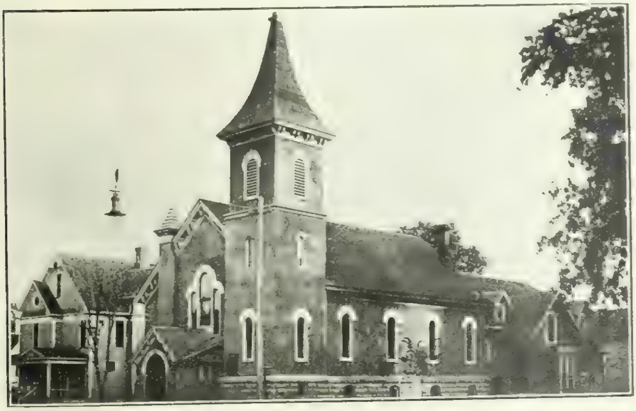
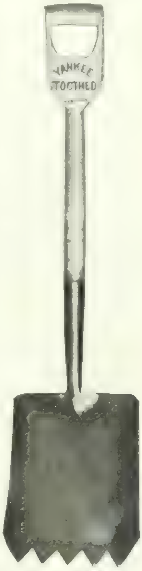


Fig. 3—Stucco-Walled Church—New Trowel Used

"Yankee-Toothed" Shovels

A shovel with a serrated cutting edge is now being manufactured by the B. B. Neal Hardware Co., New York City. Shovels and spades, marketed under the trade name "Yankee toothed," are made of high carbon crucible steel, and, the manufacturers state, special care is exercised in toughening the blade and strengthening the socket. The teeth are 1½" longer than the blade itself, and are slightly rounded at the points, thus making the teeth self-sharpening. The blade over all is 9" wide by 12¾" long, including teeth. After the teeth wear down to the body of the blade, a tool practically equal to the regular line remains. The blade and socket strap are all one piece; the handle is of the best quality of second growth ash. These tools are made in black finish only, as experience has shown that a polished tool retains the original temper with some difficulty, owing to the friction caused by polishing.



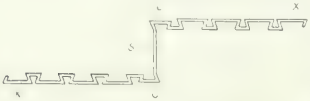
The Yankee-Toothed Shovel

When driving a toothed shovel under a load, the labor, it is claimed, is much less than with ordinary shovels. The shovel cuts into and under the material with very little friction. The weight of a shovel is about 5 lbs.

The Blaw Steel Construction Co., Pittsburgh, announces that January 1 it moved its Chicago branch into larger offices in the People's Gas Building, Chicago. The former office was in the Ashland Block, that city.

Lock-form Metal Fabric

In the past few years, there has been a continued development in mesh reinforcement toward producing a more rigid sheet. This has been done principally by introducing, in the process of manufacture, a rib of some kind which prevents to a considerable degree undue deflection in the light mesh. The accompanying illustrations show a new departure in this field, which has been developed by the Edwards Metal Structures Co., Kansas City, Mo. Plans are being hurried to place this on the market as soon as possible.



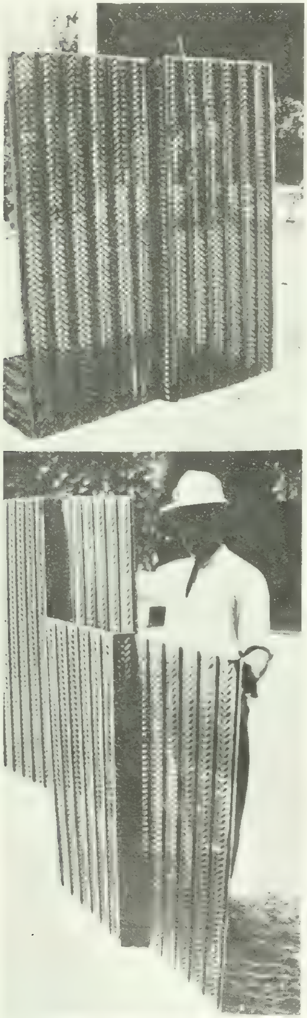


Fig. 1—Plan Detail Showing Interlocking Arrangement of Sections

Fig. 2—Sections of Interlocking Wall Fabric

In this system the ribbed and perforated metal mesh is carried from one side of the wall to the other, forming a double metal surface with an integral rib. The sections telescope and interlock, and should be readily and accurately erected in the field in actual wall work.

Fundamentally an individual plate or section comprises a metal stud *S* formed between two opposite parallel side sheathing members as seen in the plan view, Fig. 1, and in the illustration (Fig. 2). These side sheathing members have longitudinally extended dovetail corrugations formed thereon. The dovetail corrugations *C* formed on the sheathing plates adjacent to the stud member *S* are slightly smaller in cross-section than the end dovetail corrugations *X*, so that adjacent sections may be engaged as seen in Fig. 2. There the end corrugations *X* are seen being telescopically slipped upon the smaller corrugations *C* at the stud member. Such individual sections can be had in any length up to and including 12′. Thus a wall or partition of the desired height is formed, having the side sheathing an integral part of the stud members. Between the studs and the sheathing members are seen formed cells or compartments. Cross walls are built in like manner, and their end corrugations or studs telescoped within any desired corrugations on an adjacent section of the outer walls.

Fig. 3 shows the application of this system to the construction of unit steel buildings which are to be protected with paint only. This illustration is shown here to illustrate the manner in which the sections are joined. For concrete stucco work the metal is perforated or punched as shown in Fig. 2. This punching is so designed as to form a cup or lip on the outside face of the metal.

As the structure is built up, medium wet concrete is deposited within the cells in successive layers of about 8 in. each and tamped, forming a unit mass through the perforated studs. An outer covering of cement plaster is then applied to the outer surfaces of the sheathing almost immediately. Since the entire mass of concrete is in a green state and cures as a monolith, the outer coat should not chip nor scale. The work is carried on continuously in courses of about 3 ft in height, until the structure is completed. Any desired exterior finish can be obtained, such as pebble-dash, etc. Floating the exterior tends to make it waterproof.

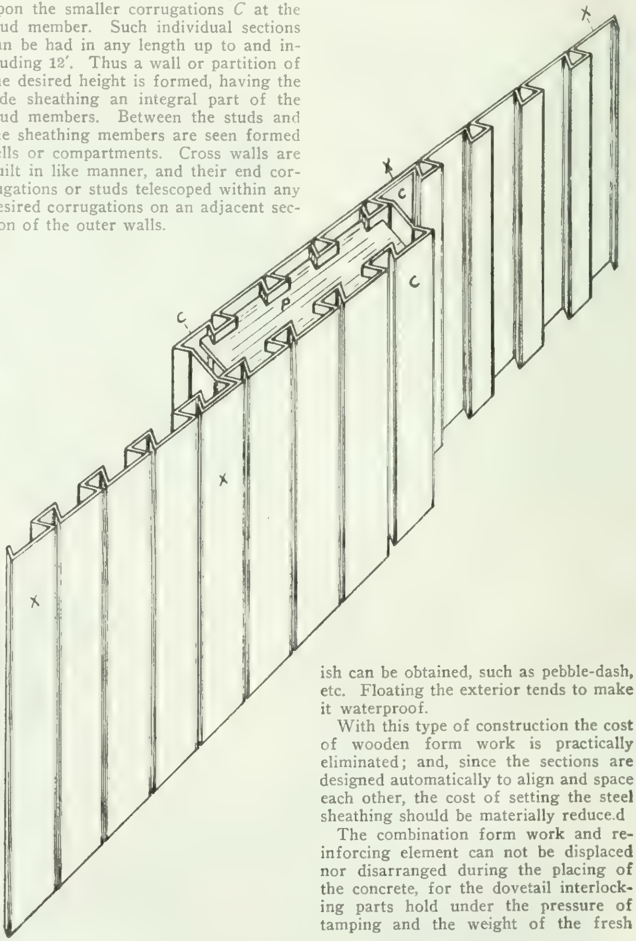


Fig. 3—Perspective Showing Arrangement of Interlocking Sections

With this type of construction the cost of wooden form work is practically eliminated; and, since the sections are designed automatically to align and space each other, the cost of setting the steel sheathing should be materially reduce.d

The combination form work and reinforcing element can not be displaced nor disarranged during the placing of the concrete, for the dovetail interlocking parts hold under the pressure of tamping and the weight of the fresh concrete. The inspection is confined to the proper grading and mixing of the concrete materials and to the proper placing of the concrete within the forms and on the coating of the exterior.

The sections nest together for shipment, and are easily handled and erected by any workman. Various weights or gauges of steel sheets are employed as may be necessary properly to furnish the desired steel reinforcing section. The stud members can be made of any desired width or spacing, to the end that the metal structure shall perform its office to the best advantage.

The combined form and reinforcement should be of particular value to farmers. With but small cost for skilled labor, they are enabled to erect almost any type of fireproof farm structures, such as barns, silos, tanks, etc. For tank and silo work, the outer sheathing member of each section is slightly greater in length than the inner member, so that the sections when combined are forced to take the proper curve. The dovetail corrugations are omitted in the outer belt and a slight change made in the interlocking parts. Sections of the reinforcement may be omitted and in their place window and door frames of steel telescopically inserted within the interlocking parts, thereby furnishing openings in the structure, the reinforcement, however, remaining continuous.

The above construction is fully covered by letters patent in the United States and foreign countries and will be marketed under the trade names of "Lockform" and "Lock-rib."

Carrying Equipment on Bridge Construction

In general, contractors are alive to the importance of using labor-saving machinery, even on jobs which last but a short time. The saving, in such cases, is often considerable, but in contracts which extend over many months, the installation of labor-saving machinery is more important and the economies correspondingly greater.

In the erection of the Atherton Ave. bridge[1] over the Pittsburgh Junction R. R., Pittsburgh, the contractors (The Friday Contracting Co.) decided that the installation of $1,000 worth of conveying machinery would be a profitable investment, particularly as the mixing plant was located on the hillside, some distance above the railroad tracks.

The machinery installed consisted of a cement bag elevator 49′ on centers, having wheeled carriers attached to a single strand of chain; a continuous bucket elevator, 60′ on centers for sand and stone, and an inclined belt conveyor 16″ wide and 180′ long, connected by chutes with both elevators, so long that it could handle either bags or the sand and stone. The foot of the stone elevator was placed below the track level, so that the material could be handled from drop-bottom cars, and the foot of the bag elevator placed conveniently to the door of a box car on the siding. A 10-h. p. motor, placed near the head of the elevators, drove all three machines, the elevators being controlled by clutches, so that either of them could be stopped while the other was elevating material.

The conveyor machinery for this entire outfit, which is shown in the picture, cost less than $900, and was erected by the purchaser's own men, from drawings furnished by the Link-Belt Co., Philadelphia and Chicago, who designed and built the machinery. Approximately 8,900 cu. yds. of sand and gravel and 48,000 sacks of cement have been handled by this outfit. In practice, one man was able to unload a car of gravel in about one hour and a car of sand in about two hours. The cement bag elevator was capable of handling about 13 bags per min.

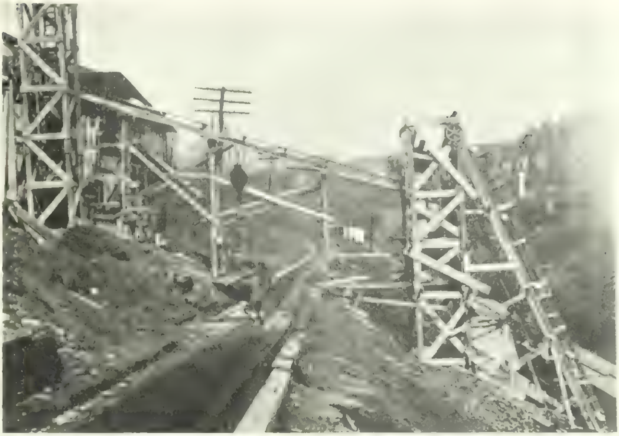


Fig. 1—Handling Concrete Materials With Conveying Equipment

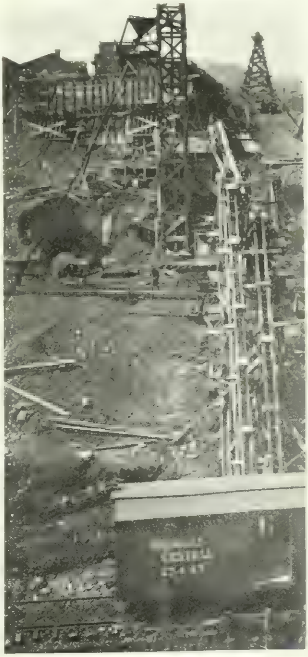


Fig. 2—Elevating Cement Sacks With Chain Conveyor

The growing tendency of the modern contractor is towards the use of labor-saving conveyor machinery—it not only cuts down the cost of handling, but reduces the number of laborers usually required on the job.

Wet Process Block Machine

A new machine, intended to use very wet concrete, in forming either two-piece or one-piece block, is made by W. D. Moore & Son, Creston, Ia. A batch of 30 slush-mix block every hour and a half is claimed for it. The block are made face up. For the body of the block, a wet mixture of 1 part cement to 4 parts sand and gravel is used, this being the method employed in the products plant of the machine's manufacturers. When the mold boxes of the machine are filled, the faces are troweled, and if the block are to have a special facing, the mold is then raised about ¼ in. and as soon as the water settles, so as not to discolor the facing, a facing is used, consisting of 2 parts white granite and

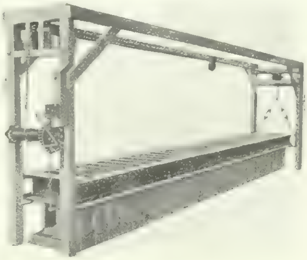


Fig. 1—Block Machine

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[1] November, 1912, issue, p. 74.

1 part of white cement (if it is to be a white face).

The machine is shown in Fig. 1 and three types of block are illustrated in Fig. 2. A brush-face block is shown at the top. For this, the facing is permitted to stiffen a little, when it is gone over with a small broom, the smooth border being put in with a tool. When the splatter-dash face is used, as shown in the center of Fig. 2, the mold boxes are raised about 1/8 in. and a thin facing mixture is troweled onto the block. The lower view in Fig. 2 is of a troweled face. The mold boxes are then raised 1/4″ and a rough-cast facing put on, the border being made with a tool. The mold boxes are lowered below the pallets and the block removed. Hot water is used in the mixture to hasten the setting of the cement. The length of time which it is necessary for the block to remain in the mold boxes is governed, of course, by the temperature of the material and the condition of the atmosphere itself. In warm weather, ordinary common block can be removed from the mold boxes in one hour and faced block in one hour and a half. With this process, it is said that ordinary block can be made as cheaply as with dry-mix methods. Faced block cost from 3 cts. to 5 cts. per sq. ft. additional.

Fig. 2—Block Faces

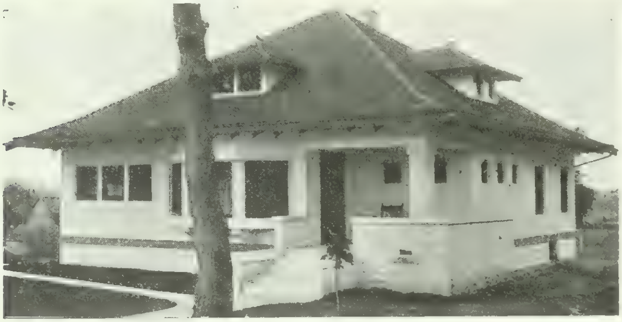
Fig. 3—Cottage of White Block

The attractive concrete block cottage shown in Fig. 3 is the home of Dr. O. E. Coakley, Creston, Ia. White-faced block were used, using white cement and white granite. E. W. Stillwell, Los Angeles, Cal., is architect and Merrill Moore, contractor.

The business building shown in Fig. 4 is also in Creston, and is 22′ by 84′ in plan, constructed of two-piece block. These were made face up in the molds and troweled. The cement used in making the block in the first four courses was mixed with lamp black, dark granite and black mica. The block were laid in black mortar and washed with a solution of muriatic acid, bringing out the aggregate attractively. White block are faced with white Portland cement and white granite and laid with white Portland cement mortar.

Fig. 4

Concrete Burial Vaults

The Norwalk Vault Co., Norwalk, O., besides being the manufacturer of the National sectional molds, makes the concrete vaults from the molds, using about 3,000 ft. of floor space in this part of the work. The business has been in operation about three and a half years and since the first year the plant has turned out about 500 vaults per year, operating six or eight sets of molds. The methods employed in handling and storing these vaults from the molds through the curing period are quite different from ordinary methods in concrete products plants. The turning device used in handling the molds is shown in Fig. 1. The frame work holding the molds revolves on the upright frame work at the end. An idea of the very wet mixture used in pouring the molds is gained from Fig. 2, in which a pailful of concrete is being poured into the molds. On being taken from the molds, the vaults are suspended from an overhead track, traveling to racks in which they are piled up in the curing rooms four tiers high. The lids are set up endways in racks. They usually remain under cover about 30 days and there are racks in the plant for the storage of about 100 vaults. The photograph, from which Fig. 2 is a reproduction, was taken at the Hercules Cement Vault Co., in Chicago, which uses the National molds.

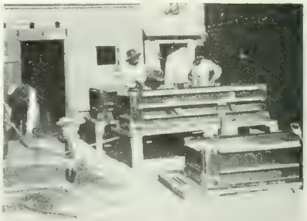
Fig. 2.—The Use of Poured Concrete in Vault Manufacture

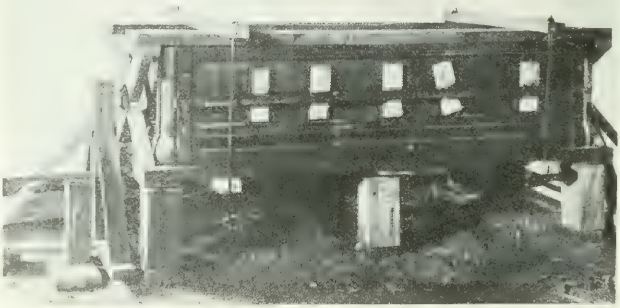
Fig. 1.—Turning Device Used in Handling Vault Molds

The Sterling Destructor. The Griscom-Russell Co., N. Y. C. 9½″ x 6¼″, paper bound, stiff covers, 48 pp. Illustrated.

Concrete-Cement Age

Vol. II FEBRUARY, 1913 No. 2

Editorials

EVERY mail brings to the editorial desk some inquiry as to uses of concrete, clearly indicative of the remarkable manner in which concrete is influencing construction developments the world over. Concrete-Cement Age readers will probably be interested in knowing that Charles J. Hastings, Medical Health Officer, Toronto, Ont., is investigating the most economical material for the construction of workingmen's houses. As he says, there have been some very excellent arguments in favor of concrete and reinforced concrete within the last year or so, and he naturally turns to this material when taking up the subject.

Better than argument is the wonderful record of the use of concrete in fireproof, low cost, hygienic homes for the workingman. The great industrial corporatitons, practically without exception, in all their house building work are using concrete exclusively. These firms are building for permanent investment and must use the material which is in every way most economical. Compare with this use of concrete the development of some of our city suburbs, where a real estate operator builds, sells and gets out from under as soon as possible. Here the most flimsy temporary frame construction is used.

We venture to say that without exception wherever an investment in homes has been preceded by careful, impartial investigation of the comparative value of the various materials available, and where the investor has a permanent connection with the property, concrete is the material selected.

Concrete-Cement Age readers will follow this probable development in concrete homes in Toronto with much interest. "Concrete Homes for Everybody" was the slogan of the May, 1912, House Building Number of *Cement Age* and every month is fulfilling this promise.

* * *

THE concrete block is altogether too good a building unit to be cast out of architecture simply because blunders have been made in manufacturing it. In this issue some fault is found with a common type of block—this is from the viewpoint of an architect. Now let many architects come forward with their opinions. This is an invitation. The columns of Concrete-Cement Age are open to you. What, in your opinion, is the present status of the concrete block and of concrete architectural stone? Further than that, what may be expected of these building units? What have you to suggest for their improvement?

* * *

AN INVITATION is also extended to everyone who contributes to the production of concrete block or concrete architectural stone—the manufacturers of equipment and the users of that equipment. What are your views of the possibilities in architecture of the building units in which you are interested? What do you suggest to improve the products? The forum is open—many want to learn.

* * *

IN connection with the proposed appropriation by Congress of a very large sum of money for the construction of a memorial to Abraham Lincoln, there are two main propositions: one is to construct a two million dollar Greek temple to memorialize Lincoln, and the other is to build a splendid national highway from Washington, the capital of the nation, to the field of Gettysburg, where, it may be said, the nation was made perfect; and along this highway to erect appropriate arches. A formal Greek temple is about the last thing which the American people would naturally associate with the simple character who holds such a high place in its memories. On his way to Gettysburg to deliver his address at the dedication of the National Cemetery, Abraham Lincoln is reported to have been nervous because he had prepared no address for the occasion and he did not know until afterward how his brief message, spoken from the heart, had gone straight to the hearts, not only of the people assembled there, but to the hearts of a whole nation. This incident is typical of his simplicity. How typical of such simplicity will a Greek temple be? A monument of borrowed architectural form erected as Representative Borland of Missouri says, "somewhere down by the brewery!" If a two million dollar memorial is to be built for Abraham Lincoln—a memorial which his memory does not need—let it be a memorial which will be simple and useful, something to be used by the people. What could be more appropriate than a national highway, built of indestructible material, from Washing to Gettysburg? With Congressman Borland we say:

"Would it not be more in consonance with the character of Abraham Lincoln that a memorial should be built for the use of the people now living than to erect one that would be costly and at the same time useless? Shall we make one that is as dead as his own mortal clay, or as vital as his immortal spirit?"

* * *

Hand Mixing is Becoming a Lost Art

Several years ago a gang of men mixing concrete with hand shovels was watched with much interest. This was the common practice on a good deal of the railroad work, practically all the sidewalk work and small jobs of almost any kind. It always seemed to us that the men moved with interesting precision, and, of course, the operation had a corresponding economy. Starting with the board clear the men would spring forward with two or three wheelbarrows of the larger crushed material. This would be wetted down with a hose or soaked with pails of water from the water barrel, and spread to a uniform height over the board. Then the sand would be dumped and spread evenly over the top of the stone. Following this, a sack or two of cement would be dumped on top of the sand, and in turn spread uniformly over the mass. The process resembled very much that of making a nice layer cake, in which the cement was the frosting.

Then two men, if they were mixing "single," would face one another at one end of the board with small, springy, square, D-handled shovels. They would go into the pile with a rhythmic stroke, swinging together and throwing the concrete materials behind them with quick, even strokes. There was a little trick in the action by which the heel of the shovel was flicked quickly and the shovel full of stone, sand and cement spread evenly over the pile behind them.

Once through the pile, the water was added. Sometimes this was done in small quantities, as the men moved through the pile, but other times it was added after the first or second mixing, and all dumped on at once.

This may sound like some of the old specifications for hand mixing, but it used to be a real pleasure to watch a gang of men turn out hand mixed concrete. When four men were mixing, a pair would be placed at either end and they would work toward the center, and then back again.

In contrast to this was some recent work observed when a gang of laborers was trying to hand-mix some material on a conduit job. The effort was really pitiable. The stone and sand were dumped on the pile together and on this heaped up mass the cement was placed, and then it seemed as though two or three men attacked the pile in a sort of frenzy, trying to stir it up with their shovels. In a little while, the water was put on haphazard, and with a little more "stirring" the mixture was dumped into wheelbarrows and sent down onto the job as concrete.

Within 200 ft. of this work, a power driven continuous mixer was putting out a well-mixed, uniform concrete at a great rate. It kept two men busy feeding, and the wheelbarrows full of concrete were getting away as rapidly as possible. Within the radius of a few blocks there were probably several power driven batch mixers at work, equipped with side loaders and hoisting towers.

Hand mixing today is a rarity. People stop to watch it because of its novelty. Power mixers on large work and hand power mixers on small work, are rapidly and completely taking the place of the little square D-handled shovels and shovel mixing will in a few years be a thing of the past. It is probably better so, for unless it can be done properly, hand shovel mixing is a dangerous factor in our present day concrete work. A decade ago any gang of laborers would probably have included several men who could turn out a good variety of concrete and turn it out at low cost with no equipment other than shovels and a mixing board. But today few laborers know how to hand mix concrete, and fewer field superintendents know how to train them. Hand shovel mixing is becoming a lost art.

* * *

A Building Failure at Cincinnati

The *Engineering News* is to be commended upon a remarkably clear and fair presentation of a building failure in Cincinnati, Dec. 10. The building in question was one being built for a moving picture theatre, 31′ wide, and 98′ 6″ long. As the account in the *Engineering News* is read it parallels in a striking manner the development of the circumstances leading up to the building failure a month before in Detroit, as described in Concrete-Cement Age for December, 1912.

The reinforced concrete work in the Cincinnati building consisted of the first floor only, supported by columns. The lot sloped downward away from the street so that practically from the footing up the wall construction was concrete columns with brick curtain walls. The original drawings, it seems, were made by a Cincinnati architect with the assistance of a capable engineer, who designed all the reinforced concrete and prepared the specifications. When the bids had been submitted and opened the owner called in a local contractor, had him revise the architect's plans and specifications and enter into an agreement to construct the building for a sum considerably less than the low bid. The owner is reported to have even gone so far as to refuse to pay the architect and his engineer for the original design and a court action was necessary, the decision being in favor of the architect.

The contractor, a carpenter by trade, sub-let the reinforced concrete work, exclusive of the forms, to a local cement contractor, who, the account states, had had practically no experience in reinforced concrete construction. The concrete work was completed without proper supervision about November 9. The point of weakness seems to have been the rear girder. In the original plans, a column had been called for in the center of the girder across the rear to carry the superimposed rear brick wall. A trunk sewer was found to come under this and changes were made under the supervision of the Building Department which omitted this column. The 13-in. brick wall had been built 22′ high across the rear girder, when, December 10, the supporting shores were removed. The collapse was probably instantaneous. One man was killed and five men were injured.

The report states that the temperature, as usual at this time of the year, had been variable and several times had dropped below freezing between November 9 and December 10. A careful inspection of the steel in the wrecked girders shows also a very poor placement of the steel. The double U-bars specified in the original drawing had not been used, and the steel was massed in horizontal planes, with no possibility of developing the full efficiency of bond or the attendant tensile strength of the steel.

This is the first reinforced concrete failure in Cincinnati, and while it is a blow to local pride it should be, we hope, a stimulus to endeavor to prevent any repetition.

Construction of an 8-Story Shop-Building

In Modern City Building Concrete Lends Economy to Rapid Fireproof Conctruction

BY JOHN N. McMICHAELS

Intensive development is the order of the day. Arcades, offering passages from one street to another, and lined with shops, have been built to a considerable extent, but in a building being completed for the Fisher estate, Woodward Ave., Detroit, the idea of affording maximum accommodation for small stores and shops has been highly developed, and the building stands unique among American buildings in its original architectural features. This phase of the work will be covered in detail by Albert Kahn, Detroit, the architect, in a later description of the design features of the building. The structural features of the building are described in the following paragraphs by John McMichaels, superintendent on the work for Bryant & Detwiler Co., Detroit, the contractors.—THE EDITORS.

The Fisher building is strictly fireproof, built throughout of reinforced concrete, terra cotta, brick and structural steel. The curtain walls are of brick, carried on a concrete girder at each story.

Foundations: Foundations, following accepted practice, were used except for certain points on the south side, where cantilever footings were used as shown in detail in Fig. 1. On account of a soft pocket found in the clay underlying some of the footings it was found necessary to make a continuous footing along the north wall, and the first three footings on the south wall. This footing is 7′ wide and 2′ 6″ thick and reinforced with four "Kahn"[1] bars 1½″ x 2¼″ and seven 1-in. ribbed bars. These continuous footings were made sufficiently strong to bridge over the pockets, and carry the weight onto the solid clay. The steel was held in place by being suspended from heavy cross-timbers, resting either on top of the side forms or from bank to bank.

Columns: The steel cores used in the interior columns are the Bethlehem "H" section, and rest on cast iron bases 4′ x 4′. The brackets supporting the beams and floor slabs are riveted to the column. Rib bars tied through the web of columns every 18″ with ⅜-in. bars, and wound with No. 5 wire on a 3″ pitch, are used. The web of the column was also drilled for the top shear bars to pass through them.[2]

The side or lot line columns are of reinforced concrete, 22″ x 42″, and designed to show as little projection into the room as possible. This was accomplished by chamfering the corners about 3 ins. A somewhat new reinforcing system was placed in these columns. Two sets of hooped spirals, 7/16-in. bars with 2¼-in. pitch, were used. Each core was reinforced with nine 1-in. vertical bars as shown in Fig. 2. The rear wall columns are of reinforced concrete with hooped column core and bars similar to side columns.

Floor System: The general plan of the building and the position of the columns is shown in Fig. 3. Flat ceilings were used throughout, and the cross-girder was entirely masked in the depth of the floor. The girder used is shown in Fig. 4. It is essentially a T-girder, 14″ deep with a flange width of 78″ and a stem width of 24″. The flange was formed by replacing two or two and one-half 12-in. tile adjacent to girder with a 9-in. tile. The flange depth is, of course, equal to this 3″, plus the 2-in. cover of concrete over the entire floor.

Details shown in Fig. 4 are for the

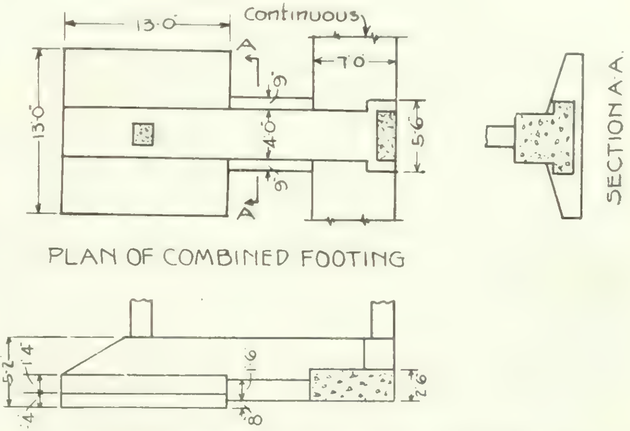

Fig. 1—Detail of Cantilever Footings Used Along the North Wall

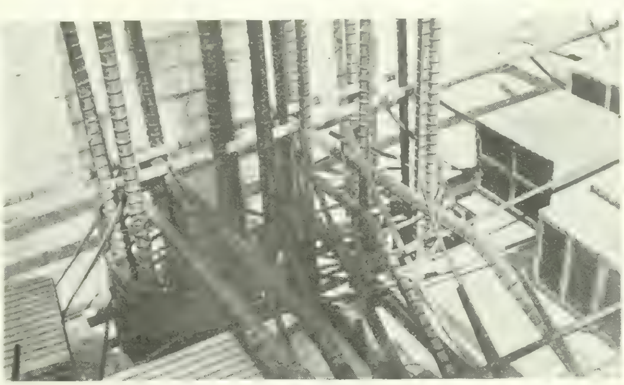

Fig. 2—Detail View of Reinforcement in the Rectangular Wall Columns

first, second and third floors. On the upper floors, 8-in. tile were used. Fig. 5 shows a detail view of the girder. Before pouring concrete, ordinary heavy brown card board was wired over the ends of the tile to prevent their being filled with concrete. This worked very well. As is shown in Fig. 5, the web of the "H" column was drilled so as to allow the trussed reinforcing bars to be carried over into next span to develop continuity. One circumstance that made some trouble was due to the existence of high party walls on either side of the building. The holes of the web of the "H" column were drilled but slightly larger than the diameter of the bar, and it was difficult to get the long bars in. The tile, as shown in Fig. 4, were set 16″ on centers, which gave a 4-in. concrete joist.

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[1] Trussed Concrete Steel Co., Detroit.

[2] Note a detailed discussion of this column detail, page 91 of the Dec., 1912, issue

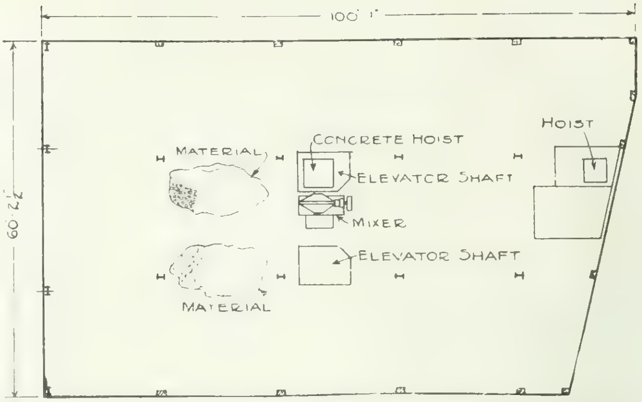

Fig. 3—General Plan of Building Showing Position of the Columns, Plant Equipment and Material Piles. The Flat Girders Run Across the Building

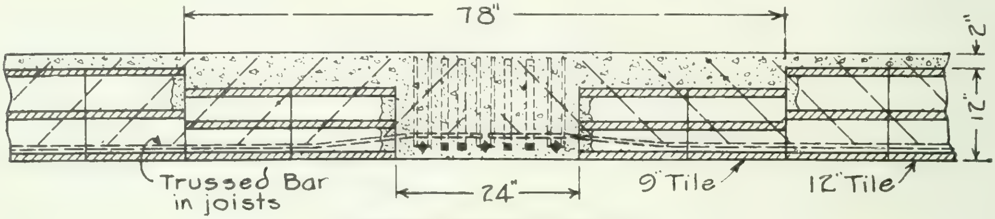

Fig. 4—Sketch Showing the Girder in Section

Centering: The centering used followed accepted practice. One detail may be of interest, and that was the way in which the centering of the second floor was arranged down the central bay of the building so that teams could drive right onto the ground floor, dumping the gravel for concrete through openings in the floor into the basement and making their exit at the other side. For this bay the shores, instead of being vertical, were inclined toward the center of the span overhead; and, to prevent displacement at the top, they were butted against 2-in. timbers on the underside of the ledger boards supporting the joists of the centering.

Concrete: The concrete mixer was placed in the basement adjacent to the northerly elevator opening (Fig. 2). For the first floor, a platform about 16 ft. x 30 ft. was built on a level with the street in front of the building. The materials were dumped through a chute under the wagon into the basement. As soon as the first floor was completed, a driveway was built through the center of the building so all concrete material could be dropped through in the basement. The entire front part of the basement was given over to the gravel used for concrete. About 100 loads would be placed before starting a floor, and it would make a pile averaging 12 ft. or so in height. From the pile, the material was wheeled around to the side-loading batch mixer, a "2-bag Smith."[3] The mixer and hoist were motor driven.

The other hoist used was in the freight elevator opening at the rear of the building, and was used by the masons for brick and tile. This also was motor driven, a 55-h. p. motor being used. The building backed on a blind alley, which terminated at this point. Traffic was very heavy on Woodward Ave., and all material had to be handled within the building limits.

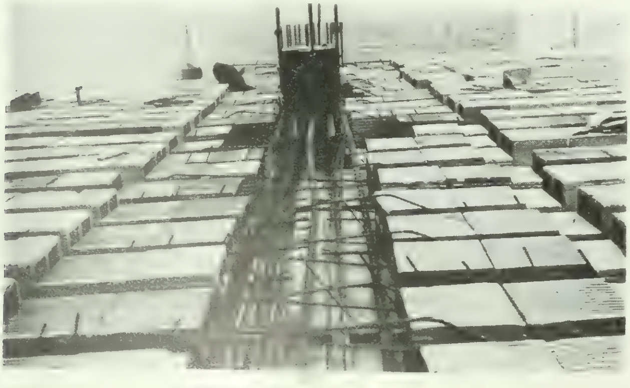

Fig. 5—Detail View of the T Section of the Girder

Concrete Tower and Spout: It was decided to use spouts to distribute the concrete, and a new tower design, which worked very well, was developed by the writer for handling the hopper and spout. As shown in Fig. 7 a regulation timber tower was built, the only change being that one pair of the horizontal girts projected about 18 ins. on the face or dumping side of the towers. These girts carried two extra vertical girders (4″ x 6″), and on these were hung the movable platform or frame which carried the hopper and spout mouth. This is shown in detail in Fig. 9. The pair of vertical "slides" fitting inside the girders are 4″ x 6″ also and the four pairs of planks bolted across are 3″ x 10″. The two platforms carrying the hopper and the suspended spout are carried from these 3″ x 10″'s as shown in Figs. 7 and 8.

This arrangement allowed the frame to be raised or lowered with a block

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[3] T. L. Smith Co., Milwaukee

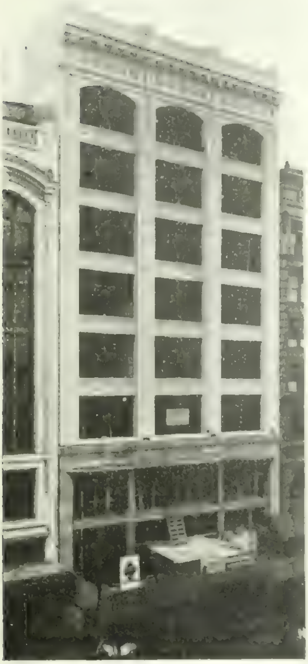

Fig. 6—The Building About Completed

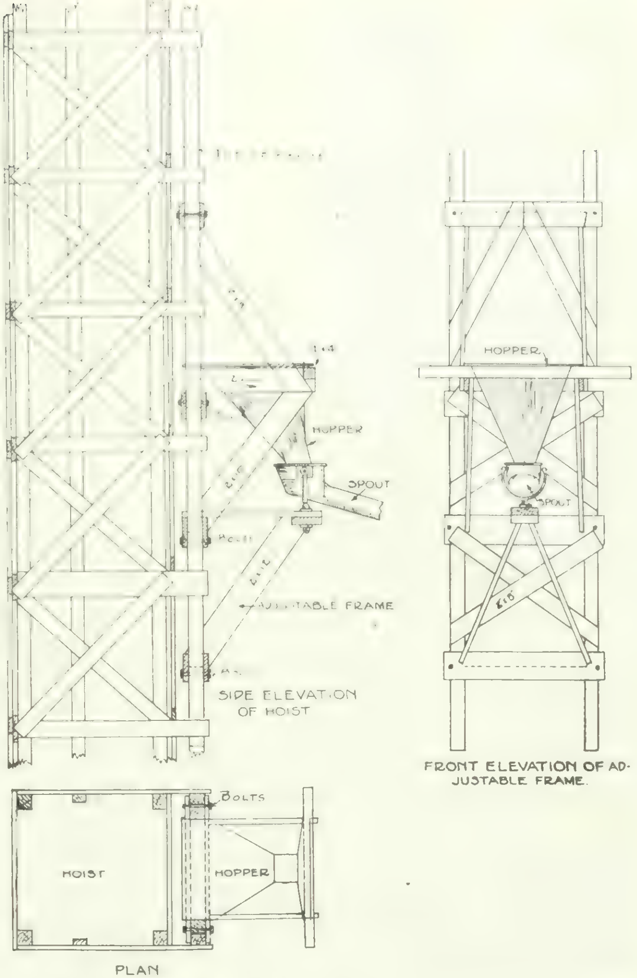

Fig. 7—Detail of Hoisting Tower Used
At the right is shown the movable frame which carried the hopper and the upper section of the chute. This frame moved up and down within the extra pair of leads in front of the tower

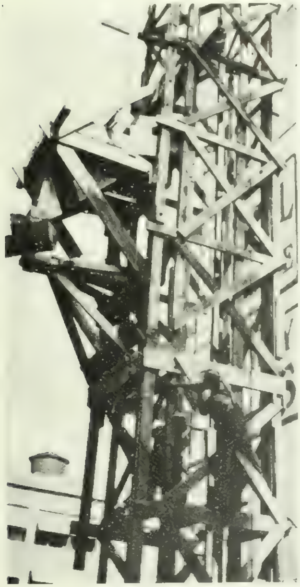

Fig. 8—Detail View of Movable Frame Carrying Hopper and the Mouth of the Spout

and falls, and when in use at any one floor the frame was bolted to the girders with four ¾-in. bolts on either side.

When a floor was completed, the line was carried to the nigger head of the engine and a strain taken on the line. The upper section of the spout was guyed in place, and the lower section looped up underneath, and held in place by a line to the frame.. The bolts were then taken out and the entire hopper, spouts and all, was raised ready for the next floor. The time taken for raising this amounted to about 30 min. to each floor.

We found this way of handling the concrete more economical and satisfactory than carrying the hopper to the top of the building and chuting the concrete down to the floors.

A floor contained about 175 cu. yds. of concrete, and the average time of pouring was 7½ to 8 hrs. Fig. 9 shows one of the floors being poured. The columns, of course, were filled first. They were filled one-half full or so, at the first pouring, and then about 30 min. later, were filled to the bottom of the floor. A 1:1:2 mix was called for in the columns and a 1:2:4 in the floor. Gravel was used throughout, and approximated the specified proportions. The cement used was Huron.[4]

In handling concrete with chutes, it was the general practice to start at a point farthest from the tower, usually in a corner, and work toward the tower, swinging the end of the chute in short arcs, back and forth across the slab. The endeavor was always to pour as

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[4] Huron Portland Cement Co., Detroit

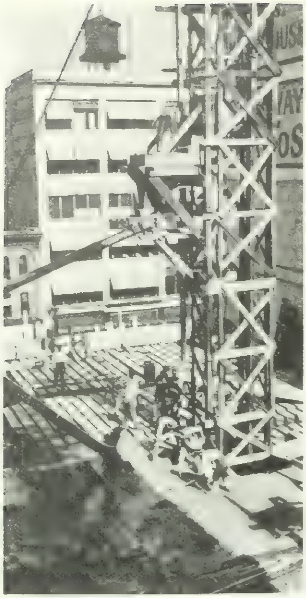


Fig. 9—General View of Floor Construction and Chuting Arrangement

much of the slab as possible without changing the position of the chute. For the far corners of the building short supplementary wooden chutes were found to work better than the heavier third section of the steel chute.

No special precautions had to be taken for the "chute" concrete other than to keep its consistency fairly uniform, and neither too wet or too dry. Concrete too wet would settle and cake in the bucket, and splash distressfully in the chute. Concrete too dry would hardly pour. The average time for completion of a floor was five days.

Fig. 10 shows the seat for a boom on one corner of the tower at the rear of the building. This was used for handling miscellaneous materials, reinforcing steel, etc.

Fig. 10—Detail View of Boom Seat on Hoisting Tower at the Rear of the Building

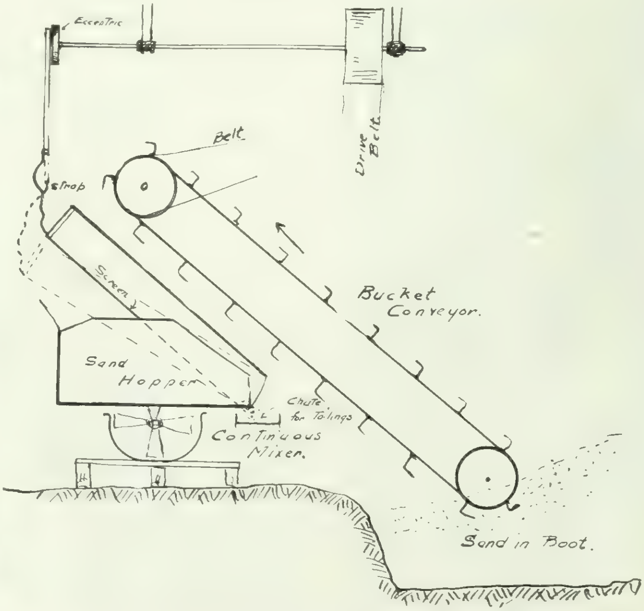
The joint congressional committee on federal aid in the construction of post roads has selected J. E. Pennybacker secretary of the American Highway Association, for the position of statistician to the committee, Mr. Pennybacker retaining his status with the Association. Jonathan Bourne, Jr., Chairman of the Committee, has inaugurated an exhaustive study of the road systems of foreign governments and of the various states. The selection of Mr. Pennybacker as statistician is in great measure due to his work as editor of the Official Good Roads Year Book of the United States, a monumental work of reference on every phase of the road subject, the first edition of which was published by the American Highway Association in 1912.

An Ingenious Sand Screening Outfit

In handling concrete products economically, it is essential that every effort be made to cut down unnecessary labor. A good many of our concrete products, such as drain tile and similar units, require screened sand, and the accompanying illustration shows an ingenious rig used to keep the hopper of a continuous mixer constantly filled with screened sand.

A side-track runs up the side of the plant and the sand is unloaded from the cars into one corner of the shed, which is left open. It is then shoveled forward into a slight excavation which serves as a boot for a chain bucket conveyor. The upper end of this conveyor is over a small screen not more than 30" x 40", placed directly over the sand hopper of the mixer, and hinged at its lower edge. The sand as it drops off the upper end of the bucket conveyor is deposited at the top of the inclined screen. The screened sand drops directly into the hopper of the continuous mixer.

The particular ingenuity of this "kink" is in the way the screen is oscillated, or rather "jerked," as shown in the accompanying sketch. A power shaft extends overhead and a short board about 2 ft. long is fastened about 3 in. off center, to a cheek rvolving at the end of the shaft. The upper end of the screen is fastened to the bottom end of the board with about a 3-ft. length of leather strap. The shaft rotates slowly and the screen is "jerked" most effectively. The only labor required in keeping this mixer fed with screened sand is the labor of shoveling the sand forward. The equipment is practically "home-made," at least it is "home-rigged."



Sketch Showing Arrangement of Screen Over the Sand Hopper of the Mixer

Concrete Stone Tooled by Machinery

Methods in Manufacture and Use of Products of the Onondaga Litholite Company

The illustrations show some achievements in concrete products manufacture and use. The Broadway Presbyterian church has recently been completed at 114th street and Broadway, N. Y. C. It was designed by Louis A. Jallade, New York; the natural stone walls are of New York gneiss, laid up in random ashlar and all the trim, including the window tracery, is of concrete stone, cast in sand molds and designated as "cut cast stone" by the manufacturer, the Onondaga Litholite Co., Syracuse, represented by the Watson Engineering Co., N. Y. C., as sales agents. Besides those of the church, illustrations are shown of two bridges built recently by the Essex County (N. J.) Park Commission in Glenfield Park, Montclair, N. J. They were designed by Frank A. Wright, N. Y. C., and were built under the supervision of A. M. Reynolds, superintendent of parks. All of the work above the reinforced concrete of the bridge structure proper is of the Onondaga cut cast stone.

The concrete stone used in the works illustrated is made with Gouverneur marble, a hard calcite product from northern New York; it is a very flinty material and in crushing breaks into sharp, angular pieces. The stone as taken from the quarry is crushed in the Onondaga company's factory in Syracuse, graded to several sizes from fines to ⅜" and stored in separate bins, later to be recombined in proportions to give the densest possible mixtures. After proportions for a mixture are determined the proper amount of stone of each size is weighed and in going to the mixer the cement also is weighed and the water added in definite proportions.

In the illustration showing the interior of the factory, the agitator which conveys the mixture from mixer to molds is seen. This agitator consists of a large receptacle, holding approximately 35 to 40 cu. ft. of material; it has a shaft through the center, revolving six paddles which are in motion constantly from the time the mixture leaves the mixer until the last of a batch is deposited in the molds. The shaft, bearing the paddles is operated by a 5-h. p. motor which is directly connected with the agitator and the entire outfit is conveyed from the mixer to any part of the shop by means of a 5-ton crane. By this method the material is constantly in motion and in process of mixing from the time it enters the mixer until it is deposited in the molds. Owing to the elevation of the agitator and the weight of the material, the mixture is deposited under sufficient pressure largely to eliminate the possibility of air pockets and to insure a uniform composition of the stone being formed. After removal from the sand molds the material is carefully cured and is then tooled and surfaced by machinery designed and controlled by the Onondaga company. While curing, the products remain at a temperature within the factory as nearly constant as possible and are then conveyed by cranes to the department where all faces of the work to be exposed are finished by grinding or surface cutting. It is believed that in this way practically all possibility of surface crazing is removed. When this treatment has been finished the stone is stored until ready for use. The entire time required to get out an order for the work is usually about 30 days. All pieces of size sufficient to require it are cast with iron anchors and setting hooks in place and each piece is tagged with the day of casting and the detail number. When the length of any stone is five times its smallest cross-dimension, it is reinforced to prevent breakage in handling and when the structural design calls for added strength it is reinforced as required.

In addititon to the method of manufacturing the concrete stone in sand molds by the Stevens process, the Onondaga company reports excellent success in manufacturing stone in rigid molds by using a jarring

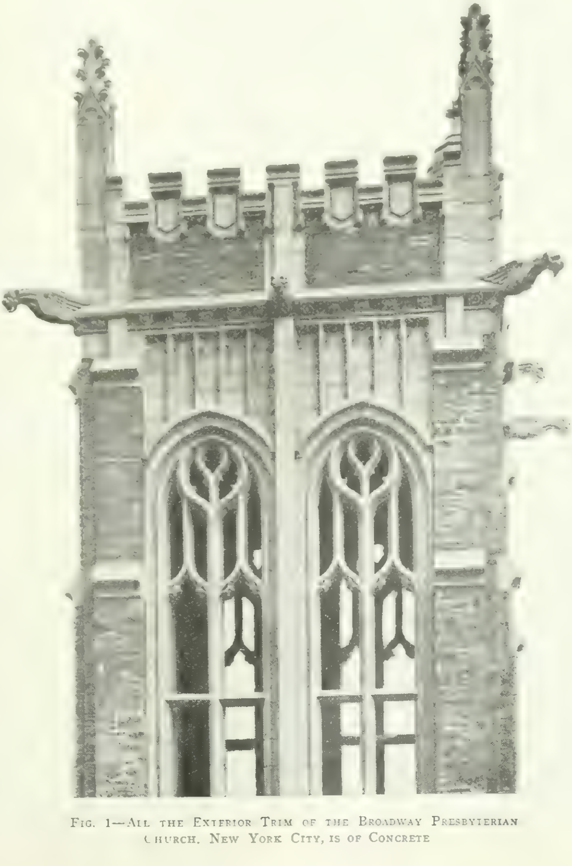


Fig. 1—All the Exterior Trim of the Broadway Presbyterian Church, New York City, is of Concrete

process. The jarring machine consists of a platform approximately 10′ x 20′ in plan, so set up as to be kept in constant vibration with a vertical rise and fall of about 6 in. This platform is operated by a 10-h. p. motor. The molds are placed on the platform and the concrete mixture is poured while the platform is in motion. The manufacturers say that this gives a very dense hard stone, fully as good in these respects as that cast in sand molds and having the added advantage of setting up more rapidly than in sand molds. This method can be used on a class of work where it proves to be more economical to use rigid molds than sand molds.

The weathering qualities of a stone are determined by its tendency to absorb moisture and in this connection, it is claimed for the Onondaga company product that being made of carefully graded marble in calcite crystals it is not only of splendid appearance when turned out of the factory but retains its beauty longer than almost any natural stone.

A resumé of official tests of the product comes to CONCRETE-CEMENT AGE as follows:

In order to receive the official approval of the New York Building Department in its several boroughs, the cut cast stone was submitted for tests under prescribed regulations, which required that an inspector of the Department should visit the factory and select stones from regular commercial products for that purpose. Stones were taken from a cast which had been made within 45 days, and these stones sawed into convenient sizes under the supervision of the inspector and shipped to the laboratory of Columbia University, which is authorized to make tests. These stones were all approximately 5″ x 4″ x 2″, and were tested within 60 days of the date of casting.

The tests were made by Prof. James S. Macgregor, and witnessed by inspectors of the boroughs of Manhattan, Bronx, and Brooklyn, and also by a representative of the company. Detailed reports covering each of the 15 different selected stones were made.

Five of these stones were submitted to compression tests in the manner usually followed for this purpose. These five stones showed an average in ultimate strength in lbs. per sq. in. of 4,953. In tranverse tests on stones from the same collection, the average of five stones in cross-bending modulus was 628 lbs. per sq. in.

Following the compression and the transverse tests, five of the specimens were submitted to water absorption testing, the stones being completely submerged in water and careful weights taken to determine absorption, which was as follows: in 30 min., 3.24%; in 2 hrs., 4.77%; in 4 hrs., 5.73%; in 24 hrs., 6.20%; and in 48 hrs., 6.28%.

In making freezing tests, five specimens of full size blocks were subjected to the test. For the major part of the test two freezings were taken every 24 hrs., except when a Sunday intervened. The duration of each freezing in hrs. ran from 9 to 40. The specimens were previously soaked in water one week and were then removed and placed in the dry freezing atmosphere of a refrigerating room with an average temperature of 13° F. Twice a day they were taken out and thawed in water varying in temperature from 150° to 200° F. This thawing required 45 min. After being thoroughly thawed, they were again placed in the freezing room, and this was repeated 20 times.

The blocks were weighed before the test began and after the last freezing, and the loss in weight was calculated in per cent, and amounted to an average for the five blocks of 0.69. All the blocks were in good condition after the freezing except for being slightly scored on their corners and edges.

In making the fire tests, three half-blocks of brick shape were placed in a gas furnace, so arranged that while the flames could play about the stones, the sharp jets of blue flame could not strike them. The furnace was cold at the start, and the heat was gradually raised in 35 min. to a total of 1,785°. When a bright red heat was attained, one of the specimens was removed and immediately plunged under a stream of cold water. The other two remained in the furnace 10 min. longer. They were then removed, one being immediately plunged in water, and the other allowed to cool in air.

Specimen No. 1, which was removed at the end of 35 min. was immediately plunged under a stream of cold water, and showed no surface cracks. Its edges and corners were sharp. Under light hammer blows the specimen gave a good ring.

Specimen No. 2, which was removed from the furnace at the end of the test and plunged under a stream of cold water showed a few hair cracks on one edge. The edges and corners were not affected by the application of water, and the specimen broke under several sharp hammer blows.

Specimen No. 3, which was cooled in the air showed several hair cracks, but its edges and corners were sharp and could not be broken by hand pressure.

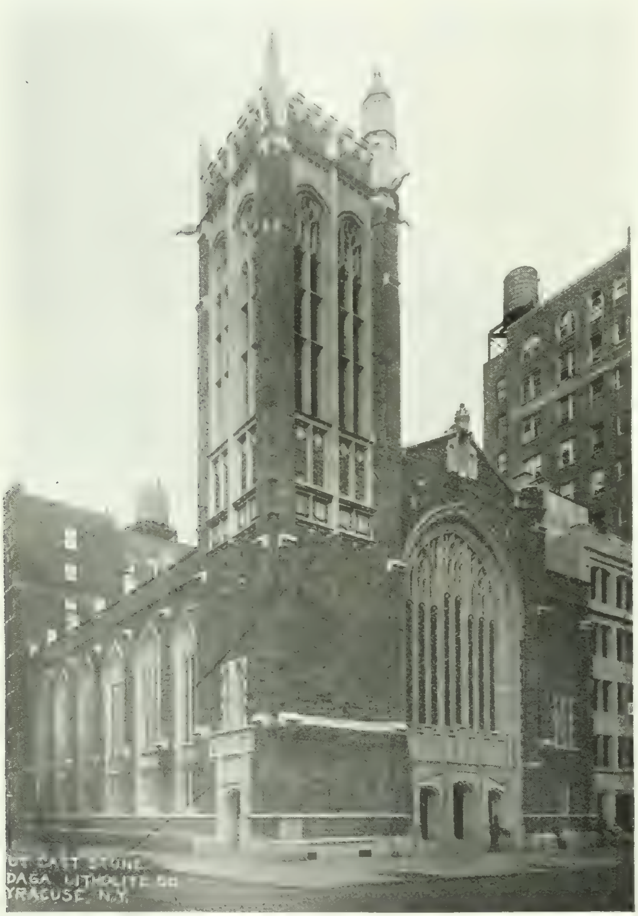


FIG. 2—THE BROADWAY PRESBYTERIAN CHURCH, BUILT OF NEW YORK GNEISS WITH TRIM OF CONCRETE

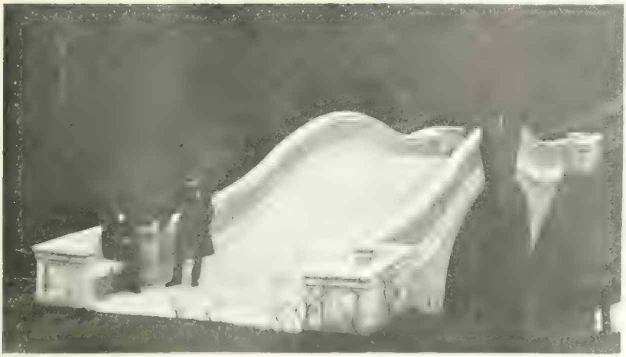


Fig. 3—Montclair, N. J., R[illegible] Concrete Bridge, R[illegible] [illegible] Made [illegible] Units

It also broke under several sharp hammer blows.

As a result of the tests the product is admitted on an equal basis with natural stone in New York City.

The Onondaga Litholite Co.'s product is not new, having been on the market for more than eight years; neither is the sand-casting process new. This particular company's development of concrete building stone has been chiefly in the matter of tooling and surfacing—machine methods have made it possible to produce a stone, which, as the illustrations show, architects have specified for excellent work. In no way has the effort been to produce a cheap product, but to produce a product better than natural limestones and sandstones with which it usually competes, at a price enough lower than these natural products to make its adoption worth while as well for initial economy as for lasting values in surface texture. It sells at from 10% to 30% less than natural stone.

The Manufacturers and Liberal Arts building and the State Grange Dairy and Press building on the New York State Fairgrounds, Syracuse, are built of the Onondaga company's cut cast stone, about 50,000 cu. ft. of the material having been used—this including 160 monolithic columns, 21' long, with Corinthian caps. Both buildings were complete four months after contracts were let and have an area of 140,000 sq. ft.

In connection with this work, concrete products manufacturers will be interested in the "Specifications for Cast Concrete Stone as used by The State of New York for the Construction of State Fair Buildings," approved by F. B. Ware, state architect, N. Y. C., and Green & Wicks, designing and supervising architects, Buffalo. These specifications follow:

All cast stone shall be made of Portland cement, such as will pass the standard specifications of the American Society for Testing Materials, and of a brand satisfactory to the architects, mixed with an aggregate, of uniform color and texture, and free from iron and other foreign material liable to discoloration. Aggregates shall be crushed *granite*, or *hard marble.*

The cement and aggregates shall be thoroughly mixed in a proportion of 1 part of cement to not over 6 or less than 4 parts of aggregate. The aggregate shall be made by crushing selected pieces of stone to insure uniform color and texture and shall be screened into at least three sizes, the largest of which shall not exceed that which passes a ring ½" in diameter, and there shall be at least 50% of such a size of aggregate that will not pass a ring ⅛" in diameter. The various sizes shall be used in proportions to give maximum density and all measured by weight.

The concrete for making the cast stone shall be mixed with not less than 15% *of water* by weight and shall be mixed by a machine, preferably of the rotary type. If cast in a semi-liquid condition, it shall be constantly agitated, and *continuously* deposited in the mold.

All casts shall be properly seasoned by being kept moist and away from the sun's rays and draughts for at least 10 days after being made.

After having been seasoned for at least 10 days, all exposed plain surfaces of the stone shall be tooled with a drove finish of four or six cuts to the inch, or such other finish, as the architects shall specify. The tooling shall preferably be done by grinding the grooves by the use of an abrasive material so that the larger aggregates will not be disturbed or in any way shattered.[1]

All surfaces of cast stone to be true and without hollows and other than

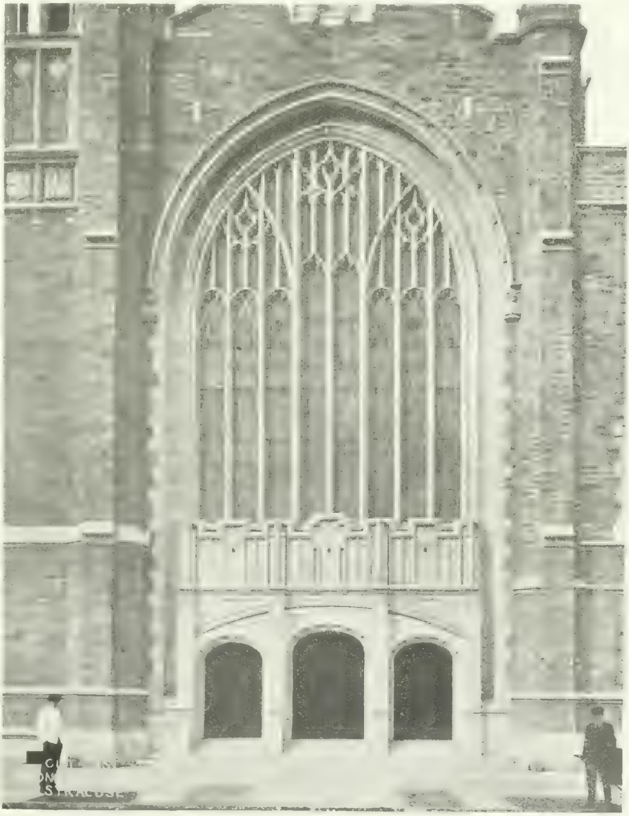


Fig. 4—Entrance to Church, Showing Concrete Trim Stone

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[1] The surface grinding machines used by the company are equipped with Carborundum discs (Carborundum Co., Niagara Falls, N. Y.) in [illegible] of about [illegible]—Editors.

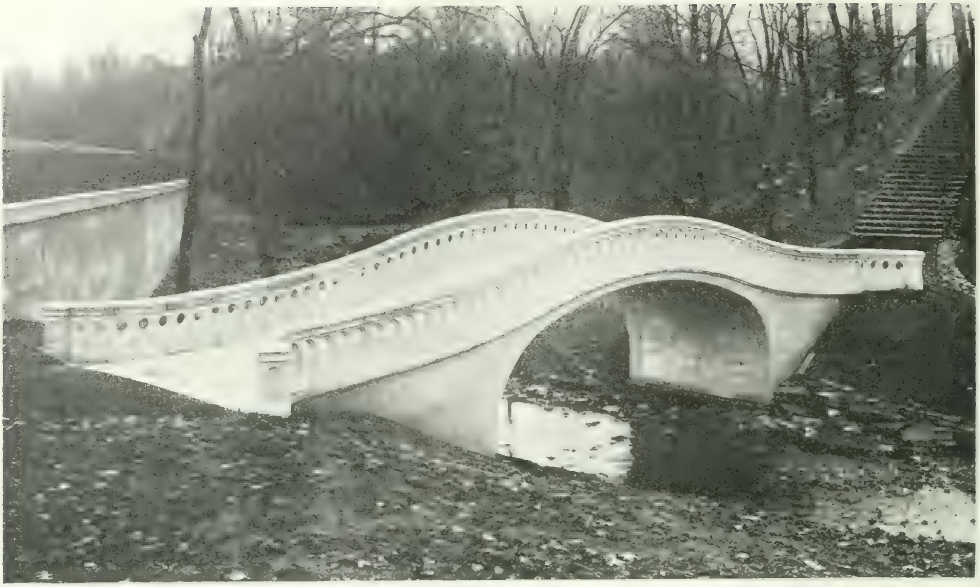

Fig. 5—Another New Jersey Bridge with Rail of Concrete Stone

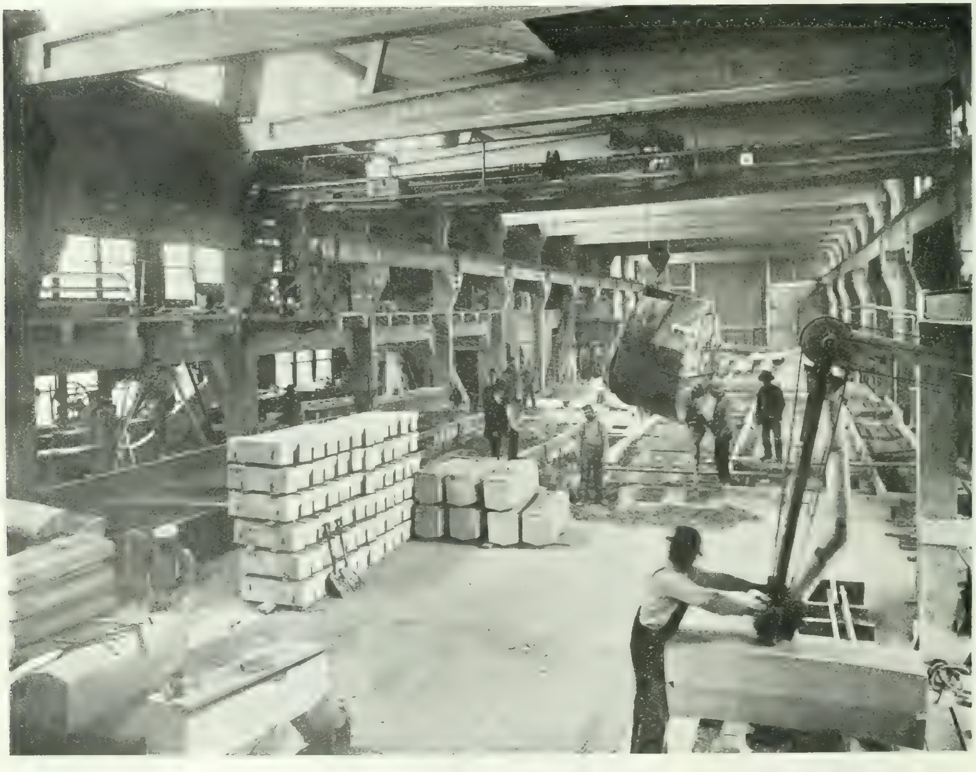

Fig. 6—Interior View of Factory of Onondaga Litholite Co., Syracuse, Where Concrete Stone is Made
In the middle distance is seen the elevator which conveys the concrete mix from mixer to molds. In the foreground at the right a man is at work with a surfacing machine

Fig. 7—[illegible] View of [illegible] in Fig. 6

plain surfaces to be recut as necessary to make perfect. Models of all ornament to be furnished for architect's approval, and all stone to be finished true to such models.

All cast stone shall be of such quality that it will pass a test at the age of 28 days of at least 1,500 lbs. compression per sq. in., and shall not have an absorption to exceed 5% of weight when thoroughly dried and immersed in water for 48 hrs.

All lintels, bearing stones, and others subjected to cross-bending shall be reinforced by means of steel rods placed about 2 in. from their tension surface and the total sectional area of the steel shall be equal to ½ of 1% of the cross-sectional area of the concrete in the member reinforced. When any cast exceeds in any dimension eight times its least dimension, it shall be reinforced to insure safety in handling.

Samples of cast stone on which bids are based shall be submitted for approval. Said samples to be *retained* by the architect. Preference shall be given to stone cast in an *established* factory, and contractor must be able to show work of a similar character that he has erected, and same must meet the approval of the architects. All casts shall be provided with steel bonds for the purpose of tying into the masonry backing and with hooks for handling and lifting which shall be placed in the stone when cast.

Cast stone need *not* be plastered on back with La Farge cement, nor need it be painted as specified for Indiana limestone.

Products manufacturers will also be interested in claims which the Onondaga Litholite Co. makes for its product: that it is made by the wet process and is uniform throughout; is so dense that an absorption of less than 5% is guaranteed; made without waterproofing compounds or chemicals; retains its color and does not stain or effloresce; weighs the same as natural stone and from 10% to 25% more than concrete stone made by any other process; made in various colors from pure white to all the colors in which natural stone occurs—the colors guaranteed permanent; is manufactured to conform exactly to architect's detail; costs from 15% to 50% less than natural cut stone.

Concrete Deposited Under Sea Water

In a paper before the N. A. C. U. at its last convention, H. R. Stanford[1] discussed in detail the development of dry dock construction, and the use of concrete by the Bureau of Yards and Docks. He described in particular the work at the U. S. Naval Station, Pearl Harbor, Hawaii, where the government is now building its largest dry dock. This dock will have a usable length of 1,000′ and will be capable of docking any vessel that can pass through the locks of the Panama Canal. The site of the dock is in a water-bearing coral rock formation, with lenticular layers of coral rock, lava mud, and coral sand alternating and overlapping each other irregularly. In building the foundation, timber crib type of cofferdam is being used. The foundation is piled and it is necessary to seal the bottom by a blanket of concrete surrounding the pile heads and of sufficient thickness to resist the hydrostatic pressure when the crib is pumped out. To deposit the concrete under water at depths of from 40′ to 55′, 15-in. diameter tremies are employed, and to obtain dense and strong concrete the bottom is divided into rectangular forms or pockets from 8′ to 10′ sq. and 8′ high.

Extensive experiments have been carried out by filling compartments and boxes under water, using varying proportions of Portland cement, lava rock screenings, crusher dust and broken lava rock, varying sizes of aggregate and varying the sand content. With the assistance of the University of Hawaii, numerous laboratory tests were conducted at the same time and cubes cut from the large test blocks were tested in compression. As a result of the tests it was determined that the concrete to be placed under water by the tremie method should be mixed in the proportion of 1 part cement, 2 parts sand and 3½ parts broken stone; and the sand itself should be 2 parts crushed lava and 1 part silicious sand. The use of silicious sand is necessary to obtain a smooth and continuous flow of concrete with the least exposure to the washing and chemical action of the sea water.

One of the large test blocks (No. 2), 4′ x 4′ x 7′, poured through a 15-in. tremie when at a depth of 55′ in the sea water is shown in *A* of the accompanying illustration. The mixture was 1:2:3½. The broken stone content was made up of 3 parts lava rock ½″ to 1″ in size and 2 parts lava rock ¼″ to ½″ in size.

After 38 days under water the block was raised and 6-in. cubes failed, when tested in compression, at a load of 860 lbs. per sq. in. Laboratory samples of the same mixture after 30 days failed at 1,355 lbs.

Test blocks of 1:3:5 mixture are shown in *B*; *C* shows a test block (No. 9) of 1:2:3½ mixture. The rock used here ran from 1″ to ¼″ and the sand was 2 parts crusher sand and 1 part Puget Sound sand.

Compression test of cubes cut from this block after 30 days showed an ultimate strength in compression of 2,075 lbs. per sq. in. and laboratory samples showed practically equal strength in the same period.

Blocks Cast Under Sea Water to Determine Comparative Value of Diferent Mixes

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[1] Rear Admiral, Corps of Civil Engineers, U. S. N., Chief, Bureau of Yards and Docks, Washington, D. C.

Concrete Block—An Architect's View*

Fault is Found with "Dry Concrete" and with Imitative Methods in Manufacture

BY OSWALD C. HERING†

EDITORIAL NOTE—A letter from Oswald C. Hering, Architect, New York City, author of "Concrete and Stucco Houses," which is published in the Correspondence department of this issue, prompted us to publish, beginning on this page, a chapter from Mr. Hering's book. This chapter expresses an architect's view of a common type of concrete block. It isn't a pleasant view. We are frank in saying that we believe many architects hold a similar view—not of all concrete block but of a common type of concrete block.

We believe in concrete block. At the same time we are trying to look at the matter broadly. There are several factors in the production and use of the concrete block. There are the manufacturer of the equipment and the user of the equipment, who makes the block, upon one hand, and the architect who specifies the block and the owner who pays for it, upon the other. It isn't enough merely that the manufacturer of the equipment and the manufacturer of the block are satisfied with what is being done. We feel sure they are not satisfied. Satisfaction is stagnation. Neither is it enough that block makers are finding a fair prosperity in supplying building block for merely ordinary structures. We believe in concrete block. We want it specified in the finest architectural work. Concrete block at its best is a building unit which fully deserves a place in the most monumental construction. It will not do for block makers to pooh-pooh the architects and insist that because of their professional training they are unduly conservative and are loath to adopt a comparatively new material in preference to the materials in which their education is grounded, thereby necessitating the study and the mastery of new problems. Mere opposition to a settled conviction never makes for progress. It is for the block equipment makers, the block makers and the block users and buyers to thresh out their differences and reach some common ground of understanding. We sincerely hope that every maker of block machinery and every maker of concrete block to whom this magazine comes will read this chapter from Mr. Hering's book, not in the spirit that an attack is being made upon him, but with a sincere desire to know how his products are regarded by at least one member of a profession upon which much of the future success of his operations must depend. Further than that, the manufacturers should consider ways and means either to convince the architect that his views are wrong or make up their own minds that in some important considerations their product is wrong and must be made better. We shall heartily welcome the freest discussion of the concrete block by its makers and its users.

The industry of hollow concrete block-making in America has been greatly injured by the fact that bad concrete blocks are so easily and inexpensively made. Cement and rubbish have been mixed and rammed into the simple machinery required, and building blocks, poor in composition and monotonous in form and color, have been turned out by the million and used to erect buildings that are eyesores in the community. There is no inherent defect either in the construction or in the esthetic properties of a well-made concrete block having a bush-hammered, tooled or plain face. In the hands of a skillful architect who appreciates the possibilities and limitations of the block, its use may be productive of durable structures of great beauty and dignity.

The so-called concrete block, meaning the "dry-process" block, of "stock" size, has been catering to popular favor for a number of years, but without marked success, no doubt because most of these concrete blocks are not concrete at all, and consequently do not perform the services anticipated from their promising name. Water is an important ingredient in the forming of concrete. The dry-process block has little acquaintance with water during its process of manufacture. Consequently it harbors an unquenchable thirst, and, when used in the outside walls of a building, it proceeds to make up for lost time, every rainstorm furnishing the elements of a "spree," to the detriment of the block. The dry-process block lacks the density and strength that are given to concrete by the admixture of a certain percentage of water (about 8% of the weight of the dry mixture), sufficient to make it plastic. Concrete of such constituents, when poured into a mold to form the block, must obviously remain undisturbed until the cement has set sufficiently to allow the removal of the mold without injury to the block. This process is too slow for the exploiter of the "concrete block," so he eliminates a greater part of the water and proceeds to make his concrete dry, or barely moist, shoveling it into a machine that rams the mixture into a sufficiently compact form to enable it to be removed in the shape of a hollow building block—but it is not a concrete block, as those who buy and use it learn to their sorrow. Even if made of the best material, it is merely a mixture of cement, sand and gravel, slightly moistened, and for the very reason that it lacks a sufficient proportion of water, it demands a supply after it is placed in the wall. Every masonry wall should be thoroughly drenched before stucco can be applied, but the so-called concrete block absorbs so much water that it generally takes all that a sprinkling will give it and such as is contained in the stucco beside. To make the wall impervious to moisture its face is then treated with a so-called waterproofing compound, but generally without success. The underlying trouble with this type of block is that its composition is fundamentally wrong.

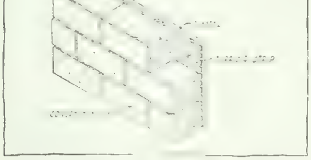
FIG. 1—A WALL OF CONCRETE BLOCKS IN WHICH THE OUTSIDE FACE OF THE BLOCK PROJECTS VERY SLIGHTLY BEYOND THE JOINT EDGE

Blocks made from a concrete that has merely been moistened will always remain soft and weak, no matter how thoroughly they are afterwards sprinkled. The ingredients should not only be properly proportioned but thoroughly mixed. Just as a chain is no stronger than its weakest link, the stability of the block as a whole is no greater than its feeblest part. Careless mixing and the addition of too little water are more often the causes of a crumbling block than too little cement.

The sight, or mention, of the "concrete block" in its present crude form, especially in imitation of "cut" and "rock-faced" stone, has been sufficient to band the architectural profession together as a unit in protest and condemnation. Not that a concrete block, if treated as concrete, is in itself an artistic impossibility — witness brick which has achieved an esthetic value by reason of its own merit, but as a cheap and vulgar imitation of stone, concrete will never be acceptable in any work of worth.

The glowing prospect of profits held out to the manufacturer has led a

(Continued on page 92)

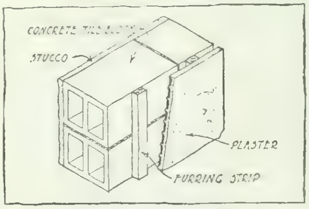

FIG. 2—A WALL OF CONCRETE TILE BLOCKS WITH STUCCO APPLIED DIRECTLY TO THE FACE OF THE BLOCKS ON THE OUTSIDE, AND THE CUSTOMARY FURRING STRIPS, LATH AND PLASTER ON THE INSIDE

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*A chapter from a new volume (1912), "Concrete and Stucco Houses," published here together with illustrations, through the courtesy of McBride, Nast & Co., N. Y. C.

†Architect, N. Y. C.

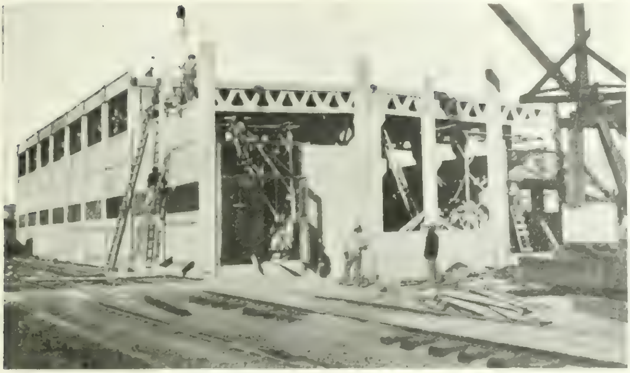

Fig. 1—U[illegible] Using a La[illegible] G[illegible]

Developments in Unit Construction*

BY JOHN E. CONZELMAN†

The large number of structures built of concrete units in the last few years indicate that unit construction methods can be successfully used for practically all kinds of reinforced concrete construction. The change in the attitude of architects and engineers toward this type of construction is nothing short of marvelous, and this is very gratifying to those of us who, within the last few years, have advocated unit construction in the face of much criticism.

In handling work under unit methods it is entirely possible to follow a well thought out program for the work in hand. The forms are bedded on the ground in a suitable casting yard and the work so arranged that a routine operation results. This means that it has finally been possible to enforce factory methods in construction operations, and factory methods, applied to the contracting field, mean order out of chaos. Forms for similar units are grouped together, thus making inspection and the checking of the reinforcement an easy matter. It is possible to make very thin sections when units such as wall slabs are cast flat. This results in economy of materials.

Past Unit Construction

To review briefly the development of unit methods in order properly to present present accomplishment: In the year 1907 William H. Mason, Supt. of the Edison Portland Cement Co., New Village, N. J., built two kiln buildings, a clinker storage building and portions of a cement storage building, using unit columns, girders and roof slabs. No attempt was made to connect these units by means of projecting bars and grout, but the columns and the girders were fastened together by means of steel splice plates and bolts. A complete description of this work will be found in the 1908 proceedings of the National Association.

In this same proceedings appears a paper on Factory Made Concrete[1] by Chas. D. Watson, which shows that the author was keenly alive to the importance of unit methods, and, while the advantages of unit methods under factory conditions of manufacture are brought out, the examples cited were mostly applications of pre-cast floor joist.

In the 1910 proceedings also there is a paper[2] on unit construction by Mr. Watson. In this paper he is able to name quite a few buildings constructed by unit methods which indicates that considerable progress had been made since his first paper. Reference is made to the following buildings:

A building constructed some time ago under the direction of the Concrete Steel Co. at Reading, Pa., for the Textile Machine Works; this was built according to the Visintini method. The cost of this building was reported excessive, and there is no record of other buildings constructed in this way.

A car barn for the Central Pennsylvania Traction Co. built at Harrisburg under the direction of Mason D. Pratt. This building is noteworthy in that walls as well as columns, girders and roof slabs were of unit construction. This building is of similar construction to the kiln buildings for the Edison Portland Cement Co. in the respect that no attempt was made to obtain a rigid or unitary structure by specially designed joints between the members.

A building for the Onandaga Litholite Co., designed and constructed under the direction of Mr. Watson, is an interesting example of unit construction. This is a one-story building with bolted connections between members.

I understand that Robert A. Cummings, Pittsburgh, has been very successful in his application of unit methods to certain types of factory buildings.

Unit Bridges: Outside of building construction unit methods have been extensively used by the railroad companies for the construction of bridges. Notable examples of pioneer work of this kind can be found in the track elevation work in Chicago. Several arch bridges of the three-hinge type have been constructed, in the extreme West, under patents granted to W. M. Thomas[3]. One

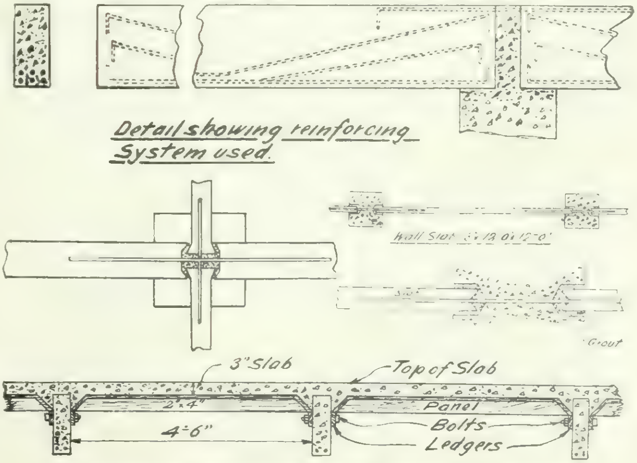

Fig. 2.—Structural Details of the Ransome System of Unit Construction

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*An abstract of a paper presented before the National Association of Cement Users, Pittsburgh.

†Ch. Eng. Unit Construction Co., St. Louis, Mo.

[1] Published in *Concrete Engineering*, Feb., 1908.

[2] In *Concrete Engineering*, Mar[illegible], 191[illegible].

[3] The first bridge of this type was built at Santa Cruz, Cal. The design and construction features were presented in detail in *Concrete Engineering*, June, 1908, in an article by Wm. M. Thomas.

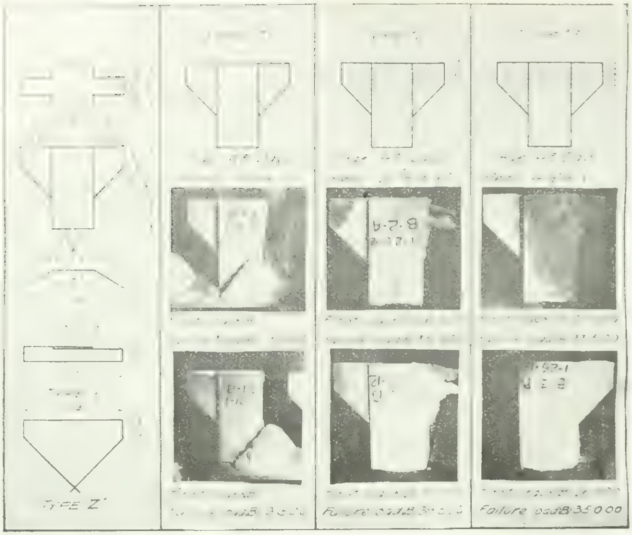

FIG. 3.—DETAIL DATA ON THREE TYPES OF BRACKETS

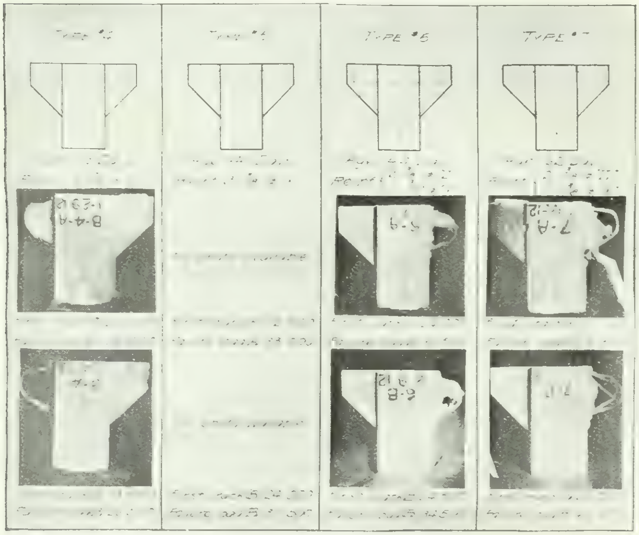

FIG. 4.—DETAIL DATA ON BRACKET TESTS

of these bridges has arches with a span of 103′.

The Ransome Engineering Co., New York, has also developed a unit method[4], and has constructed quite a few buildings; this method is a great advance over the constructions described, as it can be applied to buildings of more than one story in height. In this system, however, the floor slab is poured "in situ," making the construction only partially unitary. There have been quite a few buildings constructed by this method, and the following are the more important:

A four-story manufacturing building for the United Shoe Machinery Co., at Beverly, Mass. This building is of pleasing architectural design, being, in fact, an addition to existing buildings which had also been built under Mr. Ransome's supervision. It is stated that quite a substantial saving in cost was effected by the adoption of the unit method.

In Boston within the last two years several buildings have been constructed by this method by the local licensees of the Ransome Engineering Co.

The first application of this method was in the construction of an office building for the Foster Armstrong Co., near Rochester, N. Y. This building has brick bearing walls; its dimensions are 50′ x 60′, two stories and basement.

As the Ransome system is an important one in the development of unit methods, and has been demonstrated on considerable work, it will be described in greater detail:

In the Ransome unit system the columns, girders, beams, and wall slabs are of unit construction. The column bars are not continuous, but the concrete section is enlarged at the top and the bottom so that it can transmit the load without assistance from the steel. The ends of the girders are enlarged so as to cover the column top, the upper column setting on these ends. After the girders are erected the beams are set into notches provided for that purpose in the girders. The beams are provided with ledges for supporting the centering for the slab. The columns are also provided with a central hole for grouting purposes, and in addition, with reinforcing bars which lap each other are placed in this hole, thus giving a steel tie through the column stack. Abutting beams are tied with a steel crimp after the practice in masonry construction, and the girders are similarly connected.

In this construction the stability of the structure is to an extent, at least, dependent upon the unifying action of the monolithic slab. In regard to the design: the unit girders and beams are proportioned to carry the dead load in the course of construction; after the slab has set the strength of the beams and girders is largely increased. This is due to the fact that the slab and beams act together as if both had been poured at the same time, if sufficient projecting steel extends into the slab to insure this action.

Experimental Work

Unit construction affords a great field for research work, and in order to develop and demonstrate unit methods, the Unit Construction Co., equipped a laboratory with a 50,000-lb. testing machine and other necessary apparatus. This laboratory has proven to be a very valuable adjunct to the engineering department. Among the experiments that have been made are two series which merit description: One series was devised to throw some light on the subject of bracket design; the other on the action of girders after connection had been grouted.

Brackets: The tests on brackets were made because there is no satisfactory analysis for bracket design and no experimental data are available. It is hoped that the information derived from these experiments may be of value to the profession.

The dimensions of the specimens are clearly shown in the accompanying illustrations. The concrete was a 1:2:4 mix, the aggregate being Meramec river sand and gravel. The specimens were tested in an inverted position on account of greater ease in handling. The load

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[4] Described in detail in Cement Age, March, 1911.

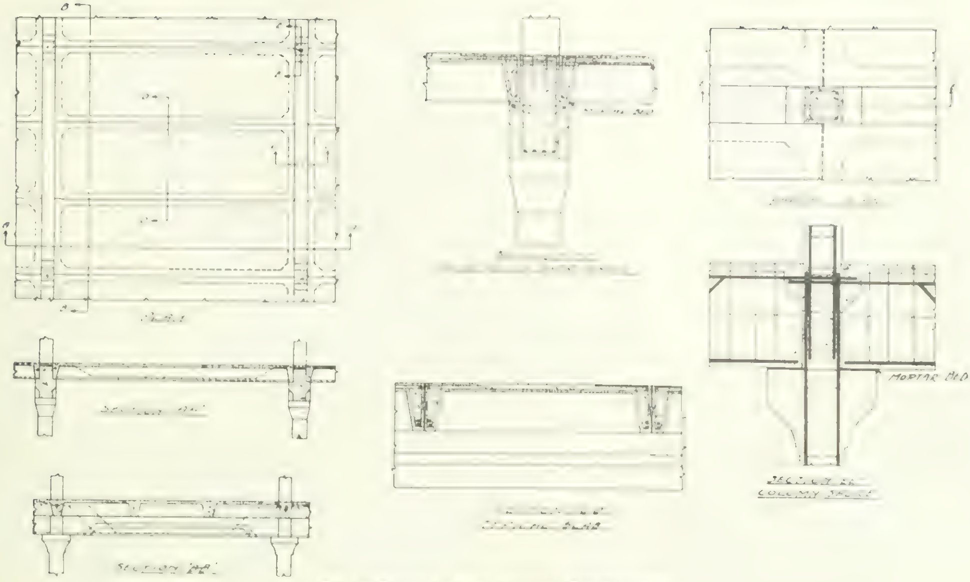

Fig. 5.—Details of Unit Building Construction

was applied through a hardened steel ball bearing in a cup-shaped depression in a heavy steel plate. The brackets tested on 1" x 4" steel plates carried on rollers as indicated in sketch. Even bearing between plates and concrete was assured by means of plaster of paris joints. Seven types of brackets were tested; type 1 being without reinforcement—the others reinforced as shown.

Three types of reinforcement were used, singly and in combination. Type *X* is a short length of bar bent downwards at either end; type *Y* consists of a single bar bent in the shape of a rectangle; type *Z* consists of a single bar bent to follow the shape of the bracket. The type *Z* reinforcement is, as you know, the type usually employed.

The specimens were tested at the age of 6 weeks as nearly as possible, except type No. 7 specimens, which were tested at the age of 62 days. Two specimens of each type were tested, and the illustrations show clearly the condition of the specimens after failure. The load causing the first noticeable crack, and the load causing failure are also shown. The position and extent of the cracks are shown in the sketch of each type.

As was to be expected, none of the specimens failed through tension in the steel. The failures were due to shearing or diagonal tensile stresses, and insufficient bond. The action is similar to that which exists at the end of a beam; the condition is aggravated, however, by the difficulty of securing sufficient bond to develop high stresses in the steel.

Although the conclusions derived from these tests are not final, yet the fact is brought out that the type of bracket ordinarily used is the least efficient of the forms tested. The failure is fairly sudden and the concrete is almost completely destroyed. The most satisfactory form is type *Y*, or closed loop. With a number of loops spaced close together the failure is slow and even after the concrete is partially destroyed considerable load carrying capacity exists. This feature is shown by the illustrations of type 3.

The average shear per sq. in. on the vertical plane of junction with the column at first load and at failure is given in the table below.

A study of these tests leads to the conclusion that the most efficient reinforcement would be the *Y* type loop bars, some of which would be bent

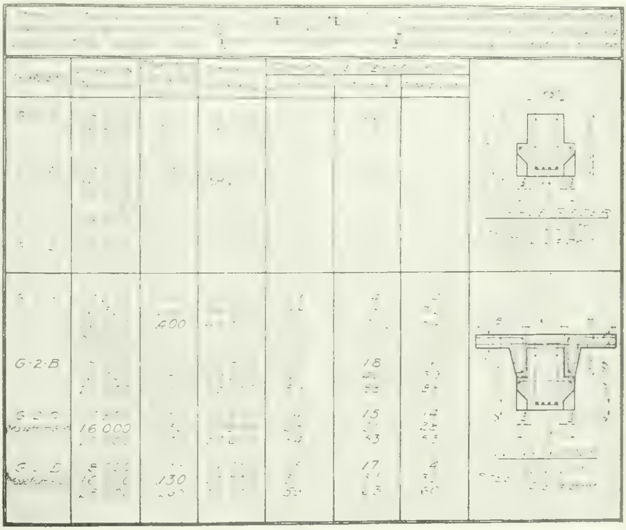
.400
G-2-B
18
15
16 000
17
.130

Fig. 6.—Results of Test Conducted to Determine Efficiency of "Wings" in Girder Compression

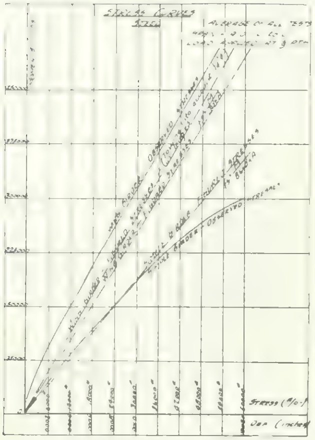

Fig. 7. Curves Showing Comparative Stresses Under Load of Simple and "Wing" Girders

downwards into the bracket. Another series of tests to determine this point is now being made.

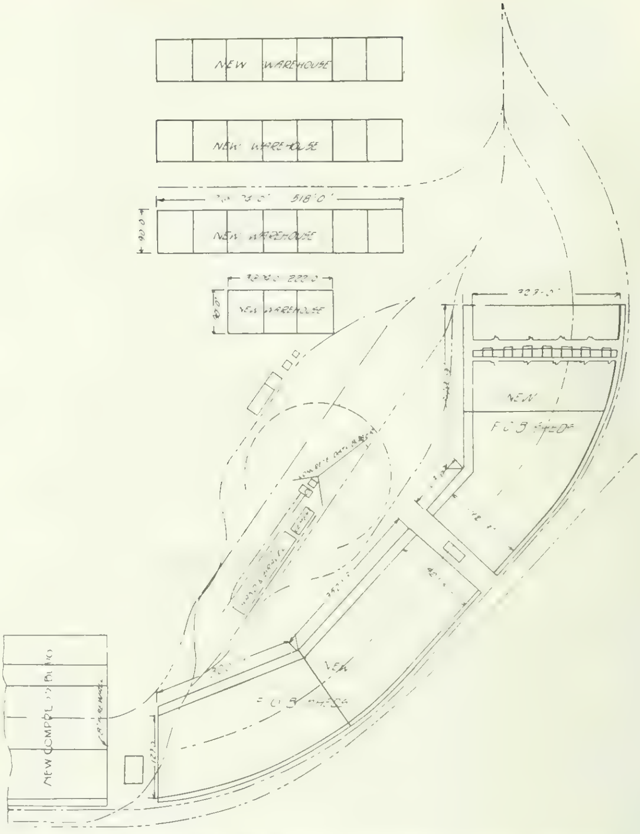

Fig. 8.—Layout of Casting Yard at Plant of The Memphis Terminal Corporation

Structural Details

The accompanying drawing shows typical details, such as would be used in the usual building. The girders rest on the column brackets. The arrangement of the main reinforcement for the girders follows usual practice, some of the bars being bent up and carried over the support. These bent-up bars project from the unit and lap the bars from the abutting girder. The length of lap is made sufficient to develop the requisite stresses in these bars. After the grout is poured we find that the girders are as continuous as in ordinary monolithic construction. The stirrups project above the girder and form loops, making strong connection with the grout which is poured on top of the girder.

Table 1.—Shear in Brackets, Developed by Different Types of Reinforcing

Type	Shear at First Crack	Shear at Failure
1	100 lbs. per sq. in.	100 lbs. per sq. in.
2	400 lbs. per sq. in.	530 lbs. per sq. in.
3	410 lbs. per sq. in.	490 lbs. per sq. in.
4	285 lbs. per sq. in.	375 lbs. per sq. in.
5	400 lbs. per sq. in.	460 lbs. per sq. in.
6	345 lbs. per sq. in.	465 lbs. per sq. in.
7	330 lbs. per sq. in.	470 lbs. per sq. in.

Floor slabs rest for their full width on the girder ledge, projecting bars extending into the grout space over the girder. It is evident that, after the grout has hardened, the strength of the girder will be greatly increased on the compression side. In other words, I-beam action results, and experiments were conducted to throw light on this action.

The results of these tests on simple and wing girders are given in an accompanying table. The wing girders failed in tension, the simple girders in compression. The concrete was a 1:2:4 sand and gravel mix; the reinforcement, high elastic limit corrugated bars. The load was applied at the third points. The extension of the steel was measured on a distance of 8" at mid-span; the deformation of the concrete was also measured, steel buttons being set in for this purpose. Readings were made to the nearest .0001", and corrections were made for temperature.

Referring to the wing girders it will be seen that the deformation of the wings agrees closely with that of the grout over the girder; this means that these wings carried their full share of stress and that full T-beam action was secured. The wing girders carried twice the load borne by the simple beams.

The curves which are shown were prepared for the purpose of comparing the action of the wing and simple girders. You will note that a comparison of the observed stresses in the steel with those figured by the usual formula is also given in this chart. The agreement between the observed and the computed stress in the case of the simple beams is remarkably close up to 30,000 lbs. in the steel. Above this point divergence must be expected, as the straight line formula used is not intended to apply to any but working loads.

Field Methods

Unit construction presents new problems to the contractor, and the problems cover not only the erection, but the casting of the units as well. The difficulties met with in pouring units differ from those encountered in ordinary monolithic work. This results from the fact that in unit work it is necessary to fill a great many isolated forms each day, while in monolithic work a comparatively large amount of concrete can be poured in about the same location. In the attempt to meet these new conditions various types of mixing plants have been tried. Two of these plants are of sufficient interest, I believe, to merit description here.

The yard layout for the Memphis Terminal Corporation work at Memphis, Tenn., is shown in an accompanying illustration. The new buildings are indicated by heavy lines, the older by light lines. In this plant the casting yard is circular, the forms being arranged around the concrete distributor. This distributor consists essentially of a structural steel arm, 130′ long, revolving through an angle of 270°. This arm is attached to a mast held by stiff legs anchored to heavy concrete footings. The arm carries three spouts as shown. With the combination of motions thus obtained, every point of the casting yard can be reached for a radius of 150′.

The mixer and the concrete hoist are placed behind the mast; a 3-way valve, operated by a man on top of the tower, directs the concrete into any one of the spouts

The casting yard is served by two locomotive cranes. These pick the units from the forms, load them on cars and push them to the buildings.

After many months of consideration, Milwaukee has finally decided to pass an ordinance governing concrete construction. The new code is said to be a model in many respects.

Investigations of Use of Cement in Ancient Crete

Writing in the *Journal of the Royal Institute of British Architects,* Noel Heaton, H. Sc., F. C. S., writes in a very interesting manner of his investigations of certain excavations in Crete which resulted in the discovery of the Minoan[1] civilization, extending back almost to the neolithic age.

While Mr. Heaton's discussion takes up, almost entirely, the use of lime plaster as a basis for the decorative paintings in the palace of Knossos, his remarks are of special interest to our readers for the reason that the lime plaster of this period is not essentially different in its composition from Portland cement mortar. The plaster contained only about 40% of carbonate of lime, the remainder consisting chiefly of silica and alumina. The analysis of a typical specimen is as follows:

Soluble in hydrochloric acid (61.57 per cent.)	Calcium oxide (lime)	24.99
	Magnesium oxide	2.24
	Carbon dioxide	16.80
	Iron and alumina	17.23
	Sulphuric anhydride	0.37
	Soluble silica	0.03
Insoluble in hydrochloric acid (38.43 per cent.)	Insoluble silica	37.29
	Alumina, etc.	1.14

This plaster was in all probability prepared by mixing lime with a type of clay known as zeolite, which consists of hydrous aluminium silicate. The hardness of this plaster was due not so much to the carbonation of the lime, as to the combination between the two materials, the formation of silicate of lime and silicate of alumina.

Strength was given to the plaster by the addition of aggregate consisting of small pebbles, shards, etc. A considerable proportion of chopped straw was added to the mixture. This was destroyed by the caustic lime, leaving well-defined cavities and in some cases, even casts in carbonate of lime.

The use of this excellent quality of plaster was confined to the early Minoan era. In the middle of the Minoan period, an inferior quality came to be used. This, while it still remains firm and sound, is not so hard or tenacious as the plaster of the earlier period. As time went on, the plaster consisted practically of burned limestone only, without any admixture. As a result of this, the hardness and tenacity obtained by the combination of the lime with the alumina silicates is lost. For the purpose of comparison, the exact composition of a specimen of this type of plaster examined is given, as follows:

Soluble (98%)	Calcium oxide	51.93
	Magnesium oxide	1.03
	Carbon dioxide	41.18
	Sulphuric anhydride	0.54
	Iron and alumina	1.81
	Alkali, etc.	1.39
Insoluble (2%)	Silica	2.12

The Minoan architecture utilized three principal types of construction. 1, Rubble and timber; 2, Gypsum masonry; 3, Limestone masonry.

Plaster in various forms was used in all classes of construction, not only as a basis for the mural decorations, but also as an architectural finish and even for a protected surface. In some cases pavements of plaster in corriders and on stair treads were utilized, and though unquestionably subjected to heavy wear, show comparatively little damage.

Mr. Heaton says that the cement utilized in this plaster was essentially a lime concrete prepared from lime of practically the same composition as that used for the plaster, but strengthened by the addition of coarse sand and pebbles.

Bearing in mind the fact that the Minoan lime plaster corresponds very closely to Portland cement mortar, it is interesting to observe that a most important key to ancient civilization has been afforded by the fact that this plaster bearing decorations has survived thousands of years. If it had not been for the unsurpassed resistance of this material, the decorations would have disappeared and much important knowledge of interest and value would have been lost.

The decorations in the Palace of Knossos have been the subject of frequent writings by archeologists, yet it is believed that the discovery of the practical identity of the plaster used with modern Portland cement mortar is novel and of value.

An amusement pier to cost $900,000 is under construction at Los Angeles, Cal., by the Great Western Amusement Co. A feature of the construction is that it is built up of blocks of reinforced concrete to form the land end of the pier.

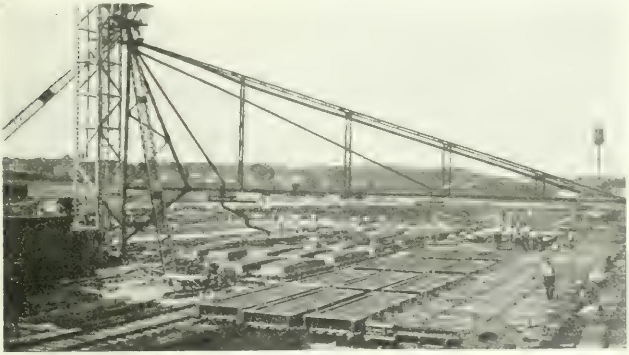

Fig. 9—Distributing Tower

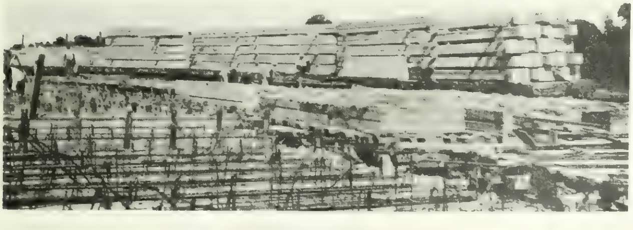

Fig. 10—Details of Casting Yard

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[1] 3000 to 1500 B. C.

"Vibrolithic" Concrete Pavement*

BY R. C. STUBBS†

Vibrolithic pavement as it is being laid in Texas, is about as follows:

The sub-grade is prepared as for any other pavement; then the concrete aggregate is brought and stored on the sub-grade. A traction concrete mixer is then brought in with charging bucket to the material and a chute is attached to the discharge end of mixer. This chute delivers the concrete to place of beginning in the street.

The concrete is composed of 1 part Portland cement and 5 parts aggregate—sharp sand and pebble portion passing a ¼" not to exceed 40%, nor be less than 33%, using as much water in mixing as the mass will retain without draining after depositing. The concrete comes directly along the chute to the street and is immediately raked to approximate grade. After an advance of a few feet, the surface is brought to a float finish by means of long-handled floats. Immediately upon this surface there is thrown a coating of crushed granite, graded from ⅝" to 1¼". This stone is applied until surplus matrix has been taken up.

This surface is then ready for "vibration;" this operation is obtained by placing platforms along or across the street. Platforms are made up of strips ⅝"x4," cleated ¼" apart, and are each 20" wide and as long as desired, cleats projecting 1" along one side, forward platform cleat projection lapping back on to other platform. When two or three platforms have been placed, a "Vibrator" mounted on roller is rolled on to the first platform and passed along from one to the other as they are put to grade and concrete is brought to a very high state of density.

As the work progresses, the platforms are brought forward and the granite surface street is immediately covered with sharp sand and wetted.

This is the first operation and completes a stone 6" thick, composed of 1:5 concrete, top 1" to 1½" loaded with stone of high abrasive resistance, a street without equaled load-carrying capacity.

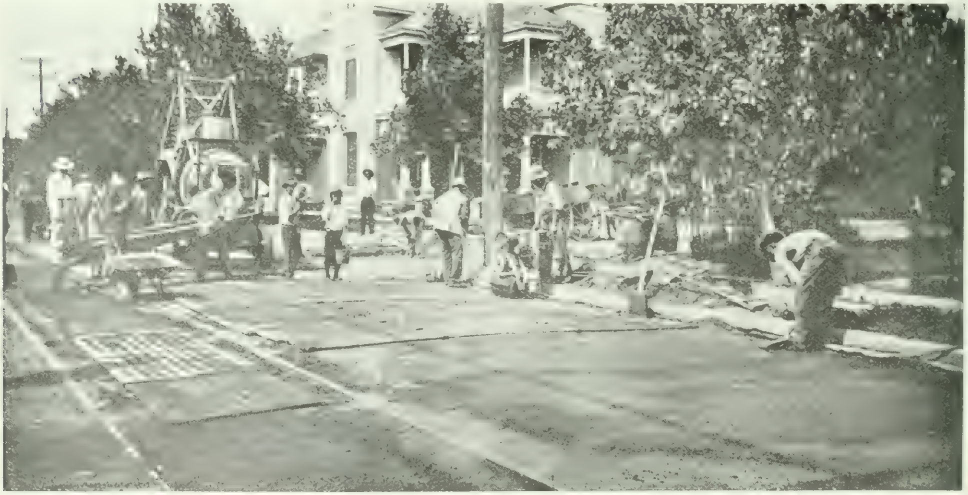
This surface being composed of granite, all parts have an equal resistance to abrasion. The granite pieces being forced into the concrete with vibration, they cannot be gotten out, but must wear out. The Vibrators being mechanical, they can be relied upon to treat all parts alike, the operator's duty being simply to roll them over platforms, to insure a concrete of equal and even texture. Evenness of texture gives uniform power, to overcome internal stresses. High density means greater strength and a reduction of contraction and expansion factor from .0000065 to .0000032.

Two or three days later the sand is swept off the surface into the gutter with stiff, wire brooms, and ¼" Tarvia A‡ is poured at a temperature of 150° F. and leveled with rubber rakes. Immediately behind the levelers, a coating of hard stone ¼" to ⅜" is spread in sufficient quantity thoroughly to coat the pitch. Upon this is spread the sharp sand that has been swept into the gutter. The surface is then rolled with a 500-lb. hand roller, and the street is held until concrete is 7 days old, and opened to traffic.

My object in placing this coat so soon is to retain original moisture in the concrete that the process of hydration may be complete. Pitch may not adhere well to a moist mortar, but it takes a firm hold on the granite surface.

After 30 days' traffic the surface irons down smooth; the small stones protect the pitch, while the sand fills the interstices, producing a very tough surface and will show a thickness of about ½ in.

I have reserved the proposition of "contraction and expansion" until I have thus far explained the placing of the pavement. Now, I will state that I handle this feature by providing for contraction *only*, that is, I do not use the usual bituminous joints to take care of expansion as well as contraction, finding that expansion comes from two causes—absorption and rise of temperature—and that contraction comes from five or more causes, the first being contraction from shrinkage in the first period of hydration. Other causes of contraction are not necessary to mention here, it being necessary to consider only the fact that contraction comes before expansion. Therefore, if the slab contains a contraction stress throughout its mass sufficient to strain



Laying a Vibrolithic Concrete Pavement

In the immediate foreground is the sand covering; the smooth space opposite first workman is finished pavement; next the operating platforms, is a long-handle float, and the "Vibrator" is shown at work, being rolled over the platforms. All platforms have been set to grade except the one onto which the Vibrator is moving. Platforms between car tracks have been set to grade and show excess moisture brought out with air bubbles between the cracks in platform; next is the granite surfacing stone being placed upon the freshly raked concrete surface. Some of this is in the wheelbarrow; next is the chute delivering the concrete to street

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*Presented before the National Association of Cement Users, Pittsburgh.

†Dallas, Texas.

‡Barrett Manufacturing Co.

the growing bond, this stress will be relieved by small cracks at irregular intervals, following lines of weakness.

My plan contemplates these cracks and forces them to come in straight lines wherever desired, by placing thin, wooden planes ½"x3" on edge upon the prepared sub-grade in such manner that they will be buried in the concrete and will occupy the bottom half of concrete cross-section.

Within 48 hours after the concrete has been laid, thin, straight lines of relief will appear over the breaker strips. In this way the street is laid monolithic, no stone being permitted of so great a size as not to have the strength to take care of its stresses, there being so general a distribution of breakers that no relief line gets of greater size than 1/16", which is barely noticeable.

I prefer this kind of joints because they do not wear off on edges like a filled joint and are more economical than an armored joint.

I assure you, gentlemen, that I did not adopt this joint for Vibrolithic pavement until I had proved that the contraction and expansion factor varied with the void, inversely with the density, and I would not use relief lines in other than highly dense concrete. If this crack is to be ⅛" or greater as it would naturally be with poured or porous concrete, I would not advise its use.

From this description of Vibrolithic, it can be seen that my theory of permanent pavement as an investment is to get the value in the base, and while I have devoted 25 years to the use and study of Portland cement and its products, learning many of its peculiarities, and believing it to be the greatest building material used, I do not believe that ordinary concrete is quite the answer, in the case of street paving, as material used for this purpose is given a most severe test.

In concrete street paving I think it is paramount that every square inch should have nearly the same strength, texture and abrasive resistance.

The Larkin Co., Buffalo, have placed a contract with the Aberthaw Construction Co., Boston, for the construction of a storage and manufacturing building at the corner of Arch and 23d Sts., Philadelphia.

The building will be 12 stories high, ranking among the high reinforced concrete structures of the country. The construction will be reinforced concrete throughout, the floors carried for part of the way on structural steel columns. Work on this building is to begin in the early spring. The cost is approximately $500,000.

The John S. Metcalf Co. Ltd., Montreal and Chicago, have been awarded a contract by the Harbour Commissioners of Montreal for a 1,500,000 bushel addition to Harbour Commissioners Elevator No. 1 at this point. It will be of reinforced concrete and steel and will cost approximately $700,000.

Concrete Block Cottages Built in England

In connection with the rural housing question which has been so much before the public of late, wide-spread interest has been created in Norfolk by the erection of cheap concrete cottages by the Wayford Tenants, Ltd., on their estate at Wayford in the parish of Stalham, N. E. Norfolk, says *Concrete and Constructional Engineering*, England. In comparison with the existing cottages in the district, which are of the usual type of poorly-lighted, badly ventilated, unsanitary farm laborers' cottages, the new concrete dwellings show to remarkable advantage from the point of view of efficiency and economy.

The cottages shown are built almost entirely of concrete. The walls are of concrete block 18"x9"x4½". All external walls are 10" thick. This allows for a one-inch cavity between the two 4½-in. blocks. It adds to the comfort of the house, insuring the inside walls being absolutely dry and of a more even temperature.

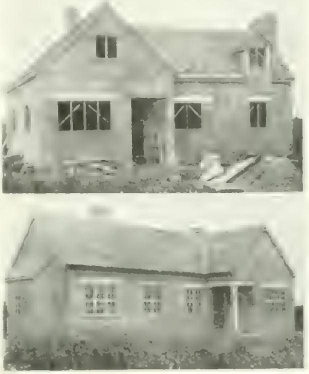


Fig. 1—Concrete Block Houses in England

The partition walls are all built of block 4½" thick. The floors are kept well above the ground level. The height between floor and ceiling is 7' 10" throughout, and there is at least one large casement window in each room, so arranged that it is possible to have a part open without inconvenience in the severest weather.

A special feature of the cottages is the roofing tiles, which are absolutely weatherproof. They are made of concrete, as are also the flooring tiles or quarries. Both of these, being glazed, give the buildings a neat finish. These tiles work out considerably more cheaply than the ordinary tile.

The cottages shown in the illustrations are of bungalow type, the rooms are commodious, and the roof is so arranged that two bedrooms could be made upstairs with little expense if required; but under the present arrangements it will be utilized for a storage loft. The sizes of the rooms are as follows:—Living room, 16'x11'; kitchen 11'x9'; larder, 5'x4'; three bedrooms, 14' 6"x10", 11'x9' and 11'x8' respectively, with a coal store 6'x5'.

Each room is well lighted and ventilated. The ceilings are of "Beaver board,"* which is composed of pure wood pulp, and which gives the appearance of a panel ceiling when finished.

At the back of each house there is an underground tank for the storage of rain-water. This is built of concrete block made specially for this purpose. The cover is of reinforced concrete, with a manhole in the center. A small pump is connected from this for the use of rain-water in the house. The size of the tank is 6' diameter by 6' deep, thickness of block 4".

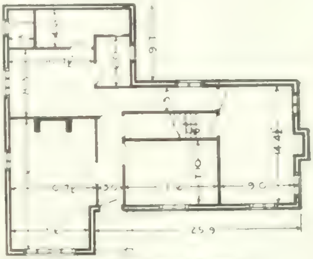


Fig. 2—Ground Floor

The cost of a cottage is £185 ($900.95) complete. By the use of brick a saving of 75% in the jointing material is effected, less plaster is required for the walls, as the surface is less rough than in the case of brick. It must be mentioned that all block, roofing tiles and quarries are made on the estate. These particulars of what is being accomplished on the Wayford Estate should convince anyone that cheap and desirable cottages can be erected of concrete on this system much more economically than by the use of brick. This should be a matter for the consideration of the Departmental Commission of the Rural Housing which has been lately appointed by the Board of Agriculture.

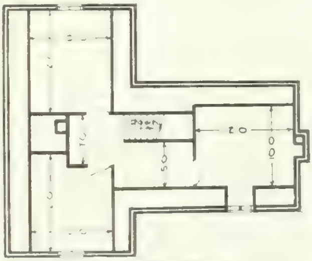
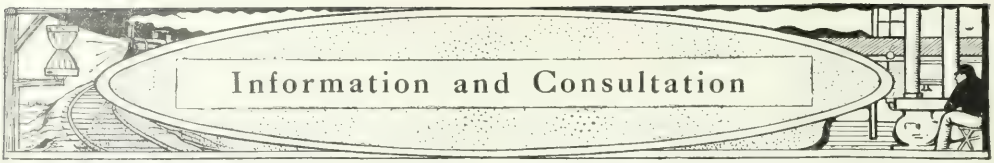


Fig. 3—First Floor

In mending broken or worn places in concrete floors or walls it is always essential, not only to soak the concrete surface before the repair concrete is applied, but the patch should be applied as wet as possible and should be kept wet for just as long as practically possible.



Information and Consultation

The Questions and Discussions in this Department are of interest and real value. Speaking for our questioners, we earnestly ask readers to discuss the questions submitted. For men in field and office, let this be a real consultation section, an exchange of ideas, among those who have, and those who have not, solved some of the problems of structural concrete. Questions and Discussions are cordially invited.

255. Action of Ammonia on Concrete

"In connection with a gas plant we have under consideration some vats for storing ammonia will be necessary. Is concrete liable to disintegrate when so used?"

NOTE: In the Sept., 1912, issue, page 69, this question was discussed by citing the construction of ammonia storage vats at Ann Arbor, Mich., by the Ann Arbor Gas Co. These tanks were built in 1909, using heavily reinforced monolithic concrete walls and floors; and, built adjacent, had an over-all length of 70′, widths of 10′ 1½″ and 8′ 1½″, and a common depth of 13′ 2″. Their combined capacity was over 45,000 gals., and they were built at a total cost of $1,688 or about $.037 per gal. The inside surface of the tanks was white washed and plastered with cement mortar concrete.

It was stated in the September issue that "at last reports these tanks were satisfactory, which is indication that ammonia can have no very actively destructive action on concrete." To bring the matter up to date, and secure first hand information, the question was put up to the Ann Arbor Gas Co., and the following letter received:—Editors.

255. Discussion by H. W. Douglas.*

In regard to reinforced concrete tanks installed by us for the storage of ammonia liquor, I would say that these tanks are still in use and show no signs of leakage. While we have not examined the cement on the inside of the tanks, it apparently shows no deterioration from the action of the ammonia. Ramming the bottom of the tank with a sharp bar seems to show that the cement is as hard as ever. These tanks have now been in use three years and we feel very much pleased with them. I can give no absolute information in regard to the condition of the cement but at the earliest date possible will have a test lump of cement suspended in the liquor for several months and we shall then be in a position to know whether or not there is any action.

* * *

275. Structural Steel Cores for Concrete Building

"In some of the more recent work structural steel shapes are used extensively for column cores. In our modern city buildings where the floor space on the first floors is valuable, the steel column undoubtedly presents a very economical and efficient construction. We would like to know (a) What is the best steel shape to use for a column and (b) What is the best connection between the reinforced concrete girder and the steel column to take care of the excessive shear?

275 Discussion by W. O. Henderer.*

We would answer *a* and *b* of the above question relative to the use of structural steel shapes for columns in reinforced concrete construction as follows:

(a) In our opinion, the best steel shape for a column used on the interior of the building, is the Gray column, as it is an ideal shape so far as placing of the reinforcing steel is concerned, and after the column has been concreted, forms a true column. It is also ideal in the way of making connections at the different floor levels, as all four faces of the column are accessible.

We use for wall columns an ordinary *I*-section column consisting of 4 angles which, when encased in concrete, make a solid column with the reinforcement out where it gives the most efficiency.

(b) In case of both the *I*-section and the Gray columns, noted above, the connection between the latticed girders (which we use) and the columns, is made in the ordinary manner of framing steel columns and girders. We have not yet had occasion to use the combination of such columns and a loose rod reinforced girder but we would conceive that, in such a case, the girders could very easily be taken care of by resting the girder on a structural shelf.

In regard to our opinion as to the merits of structural columns, the two columns noted above are, in our opinion, almost ideal for the purposes for which they are used.

* * *

280. Waterproofing a Boiler Pit

"I have a piece of work that a client wants me to keep the water out of. The water seeps through the brick and runs about 15 buckets an hour. How thick ought this to be plastered? What kind of waterproofing, if any, would you suggest to use? This is in a boiler pit and it is so low that it cannot be connected with the sewer. I believe that there is a spring opened close by."

280. Discussion by Chas. G. Ruess.*

In the executiton of waterproofing work, the first thing to be taken into consideration is the best and most economical method of keeping the surfaces to be waterproofed free to as great an extent as possible, from the inflow of water while work is being done. In cases similar to the above this is best accomplished by sinking a hole about 3 ft. in diameter, 2 ft., or so outside the pit, excavating to a depth of 18 in. to 24 in. below the floor of the pit. The water, finding an easier way of reaching its level, will naturally flow into the hole first, as it encounters considerably less resistance through the earth than through the floor of the pit, thus relieving the pressure. From this hole it can readily be pumped into the sewer, either with a hand pump, or, if the pressure is too great, with a gasoline pump which may be hired for the occasion at a nominal sum.

Considerable care must be taken in the preparation of the surfaces of this pit to receive the waterproofing. The writer recommends the removal of the mortar in the joints between the brick to a depth of ½ in. to ¾ in., and a thorough roughening of the surface of the brick with a chisel or a prospecting pick. See that the surfaces are well cleaned, and that all loose particles are removed.

Regarding the thickness of waterproofing to be applied, we find it rarely, if ever, necessary to apply more than 1 in. to the floor and ¾ in. to the walls, put on, of course, in two layers, viz., ⅜ in. and ⅝ in. on floor and ¼ in. and ½ in. on walls, scratching the first coat in both cases with a piece of wire lath just before it sets, so as to form a good bond with the second or finishing coat, which should be troweled smooth and dense. Form a "cove" in the cement where the wall waterproofing joins the floor waterproofing, and round out all corners. Never leave sharp corners in executing cement waterproofing work, as it is at these places that water is most likely to enter.

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*Mgr. The Ann Arbor Gas Co., Ann Arbor, Mich.

*Pres. Osborn Engineering Co., Cleveland, O.

*340 E. 27th St., New York City.

After the cement has had sufficient time to set, the temporary hole dug outside the pit may be filled in, and if the waterproofing medium used is of first class quality, the pit will be dry and remain dry. In the selection of a waterproofing material, careful consideration should be given to its composition and lasting qualities, not merely to its first cost. It is to be regretted that so many people to-day, contemplating waterproofing work, are attracted by the low cost of some of the "waterproofing" materials which have but a temporary chemical action on the cement, and render it apparently "waterproof" until the bill is paid. Repairs to this kind of work always amount to more in the end than if a reliable waterproofing compound had originally been used, to say nothing of the trouble and inconvenience caused. Look into the composition of your waterproofing material and see that its qualities are permanent.

The method of waterproofing above described will be found practicable against any pressure of water, and was successfully employed several months ago at Bayshore, L. I., in the erection of a hotel, under which a cellar 7' deep was provided for. Water was encountered 12" below the surface of the ground and it required the continuous use of two pumps of a capacity of 17,500 gals., per hr. to keep the excavation clear of water. A waterproofing compound was added to the cement mortar and applied to the walls and floor, rendering them absolutely watertight.

* * *

285. Sweating of Concrete Roofs

"We have had considerable difficulty with the condensation of steam on the underside of a concrete roof. The water caused by the condensation drips on to the machinery and is quite an annoyance. We are now building an addition and wish you would suggest some way of obviating this annoyance."

285. Discussion by Leonard C. Wason.*

If the air is moist and hot, as over the dryers of a paper machine in a paper mill when the weather is cold outside, provision must be made to prevent condensation. Even with the best provision it is necessary in some places to provide for adequate ventilation, as dripping will occur whenever the air reaches the dew point. A thick concrete slab requires some insulation even under only moderately bad conditions of dampness inside the building. Some of the roofing companies provide roofing quilt, which goes on under the regular waterproofing of the roof surfaces. The disadvantages of this quilt come from the fact that being cellular it is soft, and walking on the roof or particularly moving any heavy weight about on it will cut the roofing very easily. There is also the question of the permanence of the materials used in the quilt. The cheapest and one of the most efficienct methods of insulation is to use on top of the roof slab a filling of porous concrete made up of screened cinders and cement. W. H. Ham, of the engineering office of French & Hubbard, Boston, specifies as follows for such filling. His object is to get as spongy, porous material as possible and one that will have some cohesion with a mortar coating so that the roofing felt can be mopped down onto it.

Cinder Fill. Concrete roofs shall be covered with a cinder concrete fill of thickness as shown. This fill to form crickets and other grades as indicated, minimum thickness, however, to be not less than 3 in.

Concrete for this work shall be mixed with 1 part by volume of Portland cement, fulfilling specifications required for other portions of the building work, and not more than 10 parts by volume of clean, steam boiler cinders.

The fill shall be placed as carefully as possible so as to be left porous. After the fill has set up sufficiently to work over, the top surface shall be troweled over with a flat coat of mortar to give a proper surface for the tar and gravel or other roofing material.

The Aberthaw Construction Co. has had difficulty with roofs on which it has used blast furnace slag covered with 1 in. or more of sand finish, as the finish has expanded in the heat of the summer and has cocked up in big blisters.

* * *

286. Concrete Floors in Soap Factories

"Do the fats and alkalies used in manufacturing soap have any effect on concrete wearing surfaces?"

286. Discussion by J. C. Heckman.*

In regard to the action of fats and alkalies on concrete wearing surfaces, we take pleasure in stating that we have a seven story refinery building, fireproofed with concrete and with concrete wearing surfaces, which has been in constant use for seven or eight years.

Our observation on this building has not indicated that the concrete surfaces were appreciably effected by alkalies. We believe that fats do have a very slight softening effect on the concrete floors. The amount of this action depends very largely on the quality of the floors. We believe that the effect on a well laid, hard finished granolithic floor, where materials are properly proportioned to secure a very dense concrete, is almost negligable. The more porous the concrete, the greater is the softening action of the fats. We have had some porous cinder concrete go all to pieces when exposed to the action of fats for any length of time. We have a concrete floor on the top floor of the refinery which is always greasy and over which thousands of barrels are rolled yearly. We have had to repair this floor several times in places where the traffic is the most dense. It is a question, however, whether or not the rolling of the barrels over the floor would have worn it out just as rapidly if the floor had not been exposed to the action of fats.

* * *

287. Oil for Waterproofing

"Where can I find complete details about tests for waterproofing of concrete with soap, petroleum and similar products?"

287. Discussion by C. W. Boynton.*

Relative to the use of petroleum as a waterproofing material, we believe that the oil which L. W. Page speaks of in the recent Bulletin on Oil-Concrete[1] would probably come under this class, as he mentions the use of "petroleum residual oils" conforming to certain specifications.

We know of one case in which experiments with crude oil were made. This was in the preparation of a design for a dam built for the West Virginia Pulp and Paper Co. Tests made at the time indicated that the addition of crude oil to the concrete mixture would tend to reduce the strength. It was finally decided not to use any waterproofing whatever in the mixture, as the Ambursen Hydraulic Construction Co., whose design was accepted, stated that the decks had been made tight by using a 1:2:4 concrete, properly mixed and placed. An article on this work appeared in the *Engineering News* Sept. 5, 1912.

The question of waterproofing for concrete has aroused much discussion of late, but we believe the subject well covered in the recent report of the Bureau of Standards, Department of Commerce and Labor,[2] known as Technologic Paper No. 3. The conclusions stated in the summary of this report coincide with our own opinion in the matter, namely, that if the work is properly carried out, concrete can be made watertight under all ordinary conditions without the addition of any waterproofing compounds.

Precautions necessary to secure this result include care in the selection of well graded materials as aggregate; proper proportioning so as to obtain a dense mixture; the addition of an amount of water sufficient to secure a mixture of quaky consistency so that it may be puddled in the forms, the particles flowing into position without much tamping; and a careful spading of the concrete against the forms when placed so as to avoid the formation of pockets on the surface.

* * *

288. Wrapping I-Beams

"What is the best way of wrapping I-beam with wire or wire mesh to prevent the concrete below the bottom flange from cracking and dropping off?"

288. Editorial Discussion. L

There are many methods devised in the field for handling this efficiently and at low cost. One of these developed by John H. McMichaels, Supt. for Bryant and Detwiler, contractors, Detroit, has been used successfully on several steel-frame buildings. It is essentially a wire clip, as shown in the sketches, placed on the bottom flange of the I-beam about 6 ins. on centers.

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*Pres. Aberthaw Construction Co., Boston.

*Supt. Larkin & Co., Buffalo.

*Inspecting Engr. Universal Portland Cement Co., Chicago.

[1] Office of Public Roads—Bulletin No. 46, "Oil Mixed Portland Cement Concrete."

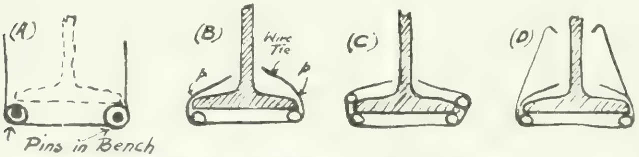
[2] Washington, D. C.

The clips are made by common labor, or the "general utility" man at odd times. Drive two ¾ in. bolts into the work bench a distance apart, out to out, approximating the width of the flange of the I-beam to be covered. Use No. 9 annealed black wire, cut to suitable length, which can be determined by experiment, and bend as shown by *A* of the accompanying sketch.

These are made up at a very low cost, and placed very quickly. They are bent down as shown in ***B.***

The important thing in this work is the point *p* as shown in *B* of the sketch. Any wire used as a tie, must be kept away from the flange so as to develop the tension in the wire. If required, two loops could be made, one at either end, to insure a better reinforcement at that point of weakness (*C* of the accompanying sketch).

Another suggestion occurs to us and that is a development of this idea some what as shown in *D* of the accompanying sketch. In this, two wires instead of one are used for each clip, one about 10 ins. longer than the other. The two wires are bent at one operation, and make one clip. These are so bent that the longer one with hooked ends is carried a considerable distance up into the web of the beam. The shorter ends are bent over the flange to hold the clip in position, the longer ones forming an end-anchored direct-pull tie. The end hook could be made with a pair of pliers.



SKETCH SHOWING ARRANGEMENTS OF WIRE CLIPS FOR I BEAM

A shows the position of the pins in the bench; *B* shows the clip placed on a beam; *C* shows a suggested double loop; and *D*, a double-ended tie with one pair of prongs extending farther into the soffit of the beam.

289. Mixing Procedure

"What is the best practice in mixing concrete? Should the sand and cement be mixed first, then the stone added, or should the stone be added at first, mixing the stone, cement and sand together?"

289. DISCUSSION BY CLOYD M. CHAPMAN.*

The relative value of mixing sand and cement together before adding the stone, or of mixing the cement, sand and stone all at one operation, is a rather difficult question to discuss. In the case of a batch mixer, I should say that it is most desirable that the stone be in with the sand and cement all the time the mixing is going on, as the stone is of great assistance in breaking up the cement lumps or particles of aggregate and also any lumps of clay in the sand. In other words, a batch mixer with the stone in it acts a great deal as the ball mill does.

In a continuous mixer, I should say that the sand and cement should, or might, mix better if they were first mixed alone, and the stone added near the end of the machine However, this may or may not be true. I am not sure.

In the case of hand mixing, I like best the arrangement of first spreading the stone on the floor, the sand on top of this and the cement on top of the sand; but all three should be spread out in a uniform layer before mixing begins and then mixing should not be, as is often the case, a process of piling in heaps. It should be turned over in broad piles, and not built up into a cone in which the fine material remains in the middle and the coarse material flows or rolls down to the outside. It should be shoveled from one broad flat pile on to another broad flat pile and back again until thoroughly mixed, and not piled into cones from one cone to another.

* * *

290. Washing Concrete Materials

"Is there any quick and easy way to wash gravel for concrete work?"

290. DISCUSSION BY E. A. WIELAND.*

If there is a concrete mixer on the job, this makes an excellent washing machine. Put in as much material as the mixer will hold and run water through it until the water is clear, then dump into the concrete hopper, hoist up same as concrete, and dump into a wooden flume to stock pile.

291. "Pecora" Cement

"What is 'Pecora' cement? We believe it is a German product, and would like further information."

291. DISCUSSION BY DR. OTTO SCHOTT.†

Pecora Cement is made in Holland and is known as an elastic roofing cement. It is red-brown in color and contains oil, which gives it a semi-pasty consistency.

An analysis shows the following composition:

Water	1.19%
Organic Matter	27.18%
Minerals	71.63%

The minerals consist of silica, iron-oxide and carbonate of lime. The organic matter, or oil, is resin oil and linseed oil. Pecora cement is used for attaching roof-slates, metal plates, to fill in cracks, etc.

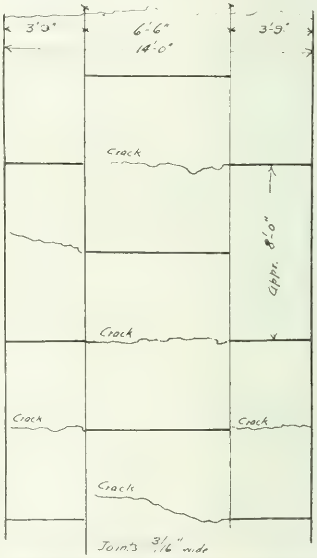
* * *

292. Cracks in Concrete Sidewalk

"I am enclosing herewith a sketch showing the jointing plan of a granitoid walk, 14 ft. wide, which I built lately. When the architect showed me this plan, I told him that these joints would crack through the adjoining block, as shown on sketch. He laughed at me. Nevertheless, they did crack through. I have noticed this to happen almost every time. I it caused by expansion or something else?"

292. EDITORIAL DISCUSSION.

With the information at hand it is practically impossible to determine definitely the cause of the transverse cracks. The important question is the nature of the expansion joint used, and in what manner it was executed. The sketch indicates apparently that the transverse joints are wider and deeper than the longitudinal joints. Assuming this to be the case, it is evident that a section entirely across the walk, and one half the length of a joint, acted as a unit, as far as expansion and contraction were concerned. This resulted in the cracks as shown.



SKETCH SHOWING ARRANGEMENT OF BLOCKS IN SIDEWALK

Further details covering the nature of the joint will be of interest; in the meantime similar problems and their solution will be welcome in this Department.

* * *

293. Coal Bin Construction

"I wish to figure on a contract for building a set of coal bins. The structure will be 18' x 100' and 18' high. The bins will be about 10' x 18', that is, the building will be divided into 10 bins. Will the cross walls made of a 8-in. x 8 in. x 18 in., hollow concrete

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*Westinghouse, Church, Kerr & Co., New York City.

*Contracting Engr., Cleveland.

†Cons. Engr., New York City.

block be strong enough? If not strong enough as a hollow block I can pour the holes full, making an 8-in. solid wall. Will it be strong enough without reinforcing? Is concrete the best material for use?"

293. Discussion by C. W. Boynton.*

Since these coal bins must be designed to withstand any stresses due to the pressure of the coal stored within them, we are of the opinion that plain concrete block construction is hardly suitable and would certainly not be economical.

We believe that the best structure would be one built of reinforced concrete, the various sections properly designed. We suggest that you secure the services of a capable engineer who can design the bins, and supervise the construction. Though such a storage shed could not be built as cheaply as one of ordinary timber construction, a brief consideration of the relative merits of the two types will serve to show the ultimate economy of the former. A timber shed would require yearly expenses for repairs and painting from the time it was first constructed, and these would tend to increase rather than decrease in amount. It would be necessary to set aside an annual sum for insurance charges and the general depreciation of the building would also be taken into account if its true value was to be determined each year. With a properly constructed concrete shed, yearly expenses for repairs, painting and insurance charges would practically be eliminated and there would be no necessity to figure a depreciation charge on the structure.

If the relative costs of the two types are compared at the end of ten years, it will be found that the money saved by the concrete structure in that time will more than make up for the increased first cost over frame construction.

We know of several instances where round bins similar to silos are being sucessfully used for the storage of coal, ore, stone, etc., and believe it would be worth while to consider this method of construction, as the design and the reinforcing is thus greatly simplified.

Economy of Concrete Piles

In a recent discussion of concrete poles and piles by Robert A. Cummings, Pittsburgh, it is pointed out that the economy of concrete piles is based on their efficiency. This efficiency consists of:

1. Their permanence.
2. Reduction in cost of footings and foundations, which do not have to be carried to subsoil water level, as in the case of wooden piles.
3. The facility with which they can be made and driven as rapidly as wooden piles.
4. Their adaptability to suit all kinds of foundation soils.

CORRESPONDENCE

Concrete Block

It seems a pity that just as the last few nails were about to be driven into the coffin of the so-called "concrete" block (a block usually made of anything but concrete,—frail, porous and in attempted imitation of stone) you should print in the December issue of Concrete-Cement Age under the title "How to Produce Realistic Stone Facings"[1] an argument in favor of this abominable building unit. A curious argument it is, too, because your contributor starts out, and covers almost a whole page, with refreshingly sensible remarks upon the legitimacy of a concrete block as a building unit only to destroy the logic of his argument by a sudden right-about-face in advancing the theory that nevertheless a wrong may be committed with impunity, so long as it is not discovered, particularly when it pays.

When it is possible to make a real concrete block as durable and as beautiful as brick or stone, as logical as either of these units, yet resembling neither, why rip off the lid and expose anew the well known features of the corpse, and waste time and patience in a vain attempt to justify its restoration to life and popularity? Your contributor plunges from sense to nonsense when he avers that by making face plates "in good variety" the product may escape the obviously insincere expression given by a series of blocks of one design, and that by so doing, he follows in the steps of "nature." In the first place "nature" has no hand in determining the difference in surface texture between one pitched face stone and its neighbor, this difference being caused by the hand of the stone cutter. But even if the stones were quarried by "nature"—would she limit her output to 6 or 10 or even "57 varieties"? Furthermore to advocate the use of plates sufficient in number to "give a good variety" is to assert that two (or more) wrongs make a right.

The last four paragraphs in particular knock every prop from the opening arguments, some of the statements adding insult to injury.

When your contributor says in advocating a deceit "no one will know, *or care*," and the editor backs him up with a foot-note of approval, I suggest that both of these gentlemen are reckoning without their host. No reputable architect will advocate the use of this block. The following dedication appears in a recently published volume dealing with the use and abuse of concrete as applied to architecture:

"This book is inscribed to The American Institute of Architects and to The Cement Industry, in acknowledgment of their mutual desire to stimulate a popular interest in the architectural use of cement products."[2]

Here is a broad hint to the interested parties "to get together." Obstinacy on the part of the architect in refusing to recognize concrete products as legitimate building units is mainly due to the pigheadedness of the manufacturer in refusing to consign his fake products to the bone yard and turn his attention to making real concrete units, truly expressing their purpose, durable, beautiful and of a size and shape required by the architect's design.

Until this requirement is recognized and accepted concrete blocks will never be used in works of architecture. Consequently until then no exposed-face concrete block industry can reach dignified proportions.

One thing more. Is it not better to do right than deliberately to do wrong and then endeavor to cover the defect with a veneer? Why does your contributor require the application of a "colorless transparent waterproofing if an impervious facing is desired?" Does he not know that a dense concrete is waterproof and that "colorless transparent waterproofing" is at best only a temporary protection to confessedly defective concrete?

Oswald C. Hering.
Architect, New York City.

Editorial Note:—The editorial note to which our correspondent takes exception, follows the statement by Mr. Doubler in the article on "How to Produce Realistic Stone Facings," that, "if the work is done with skill the result will be such that when seen in the wall no one will know *or care* whether it is natural or artificial stone." The editorial note itself was as follows:—"The italics are ours. This is the nub of the whole matter of reproduction. It is not to deceive—it is to satisfy in itself."

Perhaps this idea requires a little development. Cut stone has been used so long that we are accustomed to associate its characteristics, particularly in surface treatment, with nothing else in the world but cut stone. As we see it, the value of stone with pitched faces is in relieving sameness and monotony. The irregular surfaces give a play of light and shade, which many people find very pleasing. We know of no very good reason why a manufacturer of concrete stone should not do anything he pleases to give a beautiful appearance to *his* material. It does not so much matter what tools he uses and what methods he follows to give concrete surfaces an attractive appearance. If he happens to *hew* his manufactured stone to give it variety in light and shade, (or mold it for similar results in light and shade) we think he has committed no indiscretion just because this same method has been followed for many years back in preparing natural stone for similar uses. If, however, his work is crude and unsatisfactory, owing either to the quality of his material or to the unskillfulness of his labor, he is put to much more severe criticism because the work *he* has attempted already has been done satisfactorily, using a natural stone product as the medium. This may be as it should be. However, the criticism then comes to a mere matter of the quality of the resulting product, and we think that much of the rock-face block made with the plates which have so far been available, make, as Mr. Herring says, "an abominable building unit." This is not because the block is inherently bad in idea, but because it leaves much to be desired in the treatment. Variety of surface, the play of light and shadow, avoidance of monotony, these are the things for which the concrete stone manufacturer sought if we are to believe him sincere, and it was not a mere imitation of the surface of natural hewn stone. This then, is the reason for the comment which we made in connection with Mr. Doubler's article: If the work is well done, everybody is going to be satisfied with the result, not by being deceived into thinking that a piece of work is done with natural stone when it is not, but because the material goes back to fundamental essentials and has a beauty of its own. Many of us have an aversion to that which merely imitates, but when a product reaches that plane where it has a quality and beauty of its own, we need not condemn it because it happens to have received a treatment similar to that given to some other material which has gone before. Concrete block has suffered because its manufacture appeared to many to be so easy. Much remains to be done by the manufacturers of concrete block machinery and much also remains to be done by the users of the machinery. At the beginning it all seemed very easy and many people went into the business of making concrete block with little knowledge either of the practical essentials or little appreciation of the esthetic values. This condition, however, is being changed and much better taste and more good sense are entering into the manufacture of concrete block, and some of the most earnest opponents of the common rock-face concrete block, as now known, are among the manufactutrers of block equipment, who still continue to sell appliances for making rock-face concrete simply because a demand has been created for this product which they cannot escape.

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*Eng. in Charge, Information Bureau, Universal Portland Cement Co., Chicago, Ill.

[1] Charles H. Doubler.

[2] From an excellent work, "Concrete and Stucco Houses," by Oswald C. Hering, a chapter from which, dealing with concrete block, is reproduced elsewhere in this issue.—Editors.

While Mr. Hering and many others will go on with their work of education, certain people will demand certain products (oftentimes because they are cheap) which others cannot recommend either for beauty or for quality. This situation will work itself out naturally, however. The architects of the country are beginning to see real merit in concrete building units. They are beginning to understand the possibilities of the material and as soon as they are positive enough in their demand for concrete products of certain kinds and qualities, such concrete products will be supplied. This we know because in some localities the product is in the market in advance of an urgent demand—the manufacturers themselves have seen the possibilities of high-grade products.

* * *

Cost of Surface Finish in Bridge Work

In finishing the concrete on the Charles River bridge, Boston, the panels in the piers and in the spandrel walls of the arches were crandalled; the belt courses and the corners of the panels on the piers, together with the label mold and under side of the arch rings were bush-hammered with pneumatic hammer; and the arch rings on their faces were "fine" crandalled.

The cost of this work varied with the location, but in general the bush-hammering, including all expenses, cost about 12½ cts. per sq. ft. and the crandalling 15 cts. per sq. ft. For the bush-hammering work the contract was made with a foreman for 5½ cts. per sq. ft. of accepted work, the company furnishing tools, air and staging and doing all shifting, this bringing the figure up to the above mentioned sum. The crandalled work, however, was done entirely by day labor.

C. S. Sergeant,
Vice Pres. Boston Elevated Ry. Co.
Boston, Mass.

* * *

Handling Small Work Economically

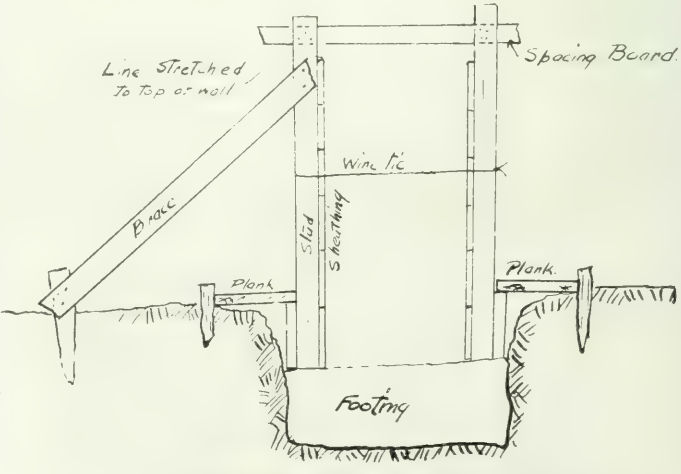
I recently put in some foundation walls, using methods which may be of interest to your readers. My plan for doing this work is as follows:

Excavate as for masonry, digging the trench wide enough to allow the footing to extend outside the foundation proper, the distance depending on the weight of the superstructure. A plank is then laid on the ground outside the trench and staked to line. To this the studs are nailed as shown. Sufficient braces are nailed to these posts to hold the tops firmly to line, and a line is stretched marking the top of the outside of the foundation wall. Then, choosing straight boards, I began at the top of the form and boarded down. Studs for the inside form are similarly placed, the tops spaced to give the required thickness of wall and the boarding on the inside begins at the bottom and is carried up as the form is filled. The two forms are securely wired together. If necessary to fill from the outside, this order is reversed and the braces put on the inside. I find it necessary to brace but one side, and this plan leaves the other clear to work from.

My mixer can hardly be called a "low charging" one. To expedite matters, I made a number of boxes of measured capacity with handles. Two men can handle 1½ cu. ft. of sand or gravel easily. These were filled by the shovelers and placed conveniently for the men loading the mixer. Two boxes of gravel, one box of sand and ½ sack of cement made a 1:3:6 mix with great accuracy, and these could be dumped into the machine in a very few seconds and the mixer started again. In fact in one run of 4½ hrs. we averaged a batch every 80 secs. mixing 5 cu. yds. per hour with a 3-cu. ft. machine I like my small machine as the gang can carry it anywhere. Gasoline furnishes the power. Two h. p. is ample.

The sloppy concrete was handled from the box into which it was dumped with ordinary grain scoop shovels. Do not use too big ones if you love your men.

This particular job was on a side hill and by keeping the mixer above the



Cross Section Sketch Showing Arrangement of Wall Centering

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[1] Universal Crusher Co., Cedar Rapids, Ia.

work there was almost no wheeling concrete up inclines. In fact most of it was shoveled directly into place.

For long low walls I made a wheelbarrow frame with a handled tray that could be lifted to dump into the forms. We found this very convenient for forms from 1½′ to 3′ high. The man who looks after the puddling can help the wheeler dump. No scaffolding is needed for these heights.

These wheelbarrows may also be used in place of the measuring boxes where the sand and gravel have to be brought some distance to the mixer. I find it much easier to move dry material than mixed concrete and for that reason I like my small, easily moved machine.

The measuring boxes for proportioning and quick charging of mixer, the scoop shovels, the wheelbarrow with removable tray, are field "kinks" which I have not seen in use on other work.

L. S. Lester.

Walsenburg, Colo.

[Note:—We might add that the plank laid flat on the ground and staked to line outside the studding is a field "kink" that is not in general use.—Editors.]

* * *

The Cincinnati Building Failure

From the recent failure of the reinforced concrete moving picture theater in Cincinnati, it is apparent that the design of this structure violated at least three of the cardinal principles of good design, safe design, in reinforced concrete, pointed out by the writer in *Concrete Engineering* six years ago. These features of design, though they are very common, have never been logically defended. Every wreck before and since that time has been characterized by several of these features.

One feature of design that has been present and has taken a prominent part in nearly all of the great wrecks is the rodded column. A column totally without toughness, excessively brittle, monolithic with the rest of a structure, cannot be expected to do anything but break up in chunks when failure once starts; and this is what these rodded columns promptly do. In this building two columns out of 13 (apparently) were not found flat on the ground. These two were broken.

Another feature, very prominently illustrated in this design, is the bunching of rods in the bottom of a beam. A large girder is shown with almost a solid layer of heavy rods. The concrete could not possibly grip these rods. The photograph clearly shows this, for the rods are practically bare for a large part of their length.

Another illogical feature is stirrups used with the delusion that they will relieve the concrete of shear. I have asked before: How is it possible for stirrups or shear rods to take the end shear of a beam when the beam can shear completely from its support without disturbing in the least this "shear reinforcement?" These foolish little rods are found clinging tenaciously to the beam, but the beam and its supporting column parted company with the greatest ease. There is exactly the same possibility of these stirrups taking the end shear of a beam that there is of a man lifting himself by the bootstraps.

The specifications for this structure are interesting. Stress in steel, 20,000 lbs. per sq. in.:—this is extremely high. Compression on concrete (presumably in rodded columns) 600 lbs. per sq. in. Not long ago a column under 200 lbs. per sq. in. failed, due to a mere jar. Shear on steel called for is 10,000 lbs. per sq. in. Since I showed, some six or seven years ago, that such units as these for shear in steel embedded in concrete are impossible and absurd, this senseless clause has gradually been weeded out of specifications, committee reports, and even building codes.

The most sinister fact of all is that every one of these practices is or has recently been standard, recommended and used by men enjoying the highest reputation in their profession. The events of last year, and particularly of the last few weeks of that year, should make any structural engineer who advocates all of the standard methods of his profession, hang his head in shame.

The issue of the *Engineering News* giving the description of this wreck devotes 31 columns to descriptions of structural failures and their consequences.

Edward Godfrey.

Pittsburgh.

* * *

Small Crushers on Concrete Work

We have a small jaw crusher mounted upon wheels with a gasoline engine, which was purchased primarily for the purpose of crushing the concrete which we removed from the track in the progress of repairs. It has been our practice to utilize this material in making concrete and for ballast as repairs progressed, but the cost of breaking this up by hand was excessive.

This crusher, a "Universal,"[1] is of such size and weight that it can be easily handled by one or two teams from place to place upon the street, so that one machine may cover all of the work necessary for several gangs. Of course, under the circumstances, on account of the broken time, it has been difficult to determine just exactly the cost per yd. for this class of work. After the repair season was finished, however,the crusher was placed in the yard where there was a large quantity of concrete, old granite block and brick that had been picked up and removed from the street from time to time, and in order to utilize this, the crusher was put to work breaking it up and loading it, by means of its elevator into cars. It was utilized for ballast on some of our open track. As nearly as we can determine, the cost of this, including labor and gasoline, amounted to 50 cts. per cu. yd.; and I believe that this would be a fair average of the cost of crushing this material upon the street.

The machine is now being used for the purpose of crushing up the limestone that we removed from some of our cuts on our opened track lines. This is crushed upon the ground and will be utilized in the vicinity for ballast.

We have found such a crusher a very useful machine, and it has saved us a great deal of money in the past season. I think it is an economical proposition in any work where quantities of concrete or stone can be again utilized if crushed.

[illegible]

Ch. Eng. Metropolitan Street Ry. Co.
Kansas City, Mo.

* * *

Concrete Stucco

Now as to methods in doing stucco work, I am always more interested in reading about it than in giving information, but here is my method and I have not had a poor job yet. This is my way on an old building for two coat work: First, see that everything is well nailed up tight, then cover the entire building with single ply tar paper. Take steel furring strips and nail 12″ o. c. and drive staples every 6″ up and down (take whatever size the job calls for, usually ¼″); then run the expanded metal lath around the job and also fasten with staples right over the furring. This must also be well nailed, also any sags that may form in between the furring. The work is then ready for the first coat of plaster. I use this quite coarse. I put my sand through a ¼-in. screen *run flat*, and take this sand and mix 3 to 1 with not more than 10% of hydrated lime. (I very seldom bother about hair). I want the first coat pushed clear through the lath and tight up to the tar paper and enough more to cover all the lath, then it should be scratched well—real rough. I like to have this well set up before I put on the next coat.

For the second coat I use a ⅛-in. screen placed on an incline of about 45° and screen my sand through this and mix this 2 to 1 with 5% hydrated lime added, and before plastering this on, I have my first coat well sprayed with water and kept well soaked, ahead of the men. This coat is generally finished with a wood float and if proper care is used in putting it on, there is not much danger that it will crack. As many more coats can be put on as desired, but for a cheap job, these two coats will give good satisfaction. The work looks fine after floating and right here is where most people's trouble starts. Most men call the job finished, but it isn't. If the weather is hot or dry, or hot winds are blowing, it should be taken care of. Just as soon as it is safe to do so, I wet it with a very fine spray and keep it damp for several days, and if possible, hang canvas up to keep the sun away from it and a little extra care in this way pays well. As to the lime, I find it is an advantage to soak it at least 24 hours before using, as it gives better results. It is not much trouble to find out when you have the right proportion of putty, which I stir in the water that I wet the cement and sand with and I also want all this mortar well mixed.

I was in Madbury, N. H., this summer to put in some cow mangers and stalls for about 50 cows, and the farmer had his barn stuccoed all over this summer. He asked me what was wrong with the job, as he was dissatisfied with it. He said he paid his men 60c per hour and board, and they were considered good men. This was a two-coat job, and I really think there was enough material used in the job to have turned out a fine piece of work, but I think they used too much lime. They used about 25%. This barn was boarded up and down, and on the face of these old boards they put the ordinary plasters' lath, which is 4' long, 1½" wide and ¼" thick. These lath they nailed all around the building about 16" o. c. (no paper back of lath); then they nailed expanded metal lath up and down the building and put on the two coats of stucco. They followed up very close with the second coat, so as to avoid letting it dry out, and for that reason I should judge that the first coat was scarcely hard enough to cover yet, and this work was never sprayed nor shaded, and was put on right in the middle of summer. This work cracked so badly that a knife blade can be run into every crack and most of the splices of the metal can be traced by the cracks. Every batch of mortar that was mixed can be distinguished.

Some people think that there is nothing to it—just to put stucco on a building, but I find it is necessary to put quite a few brains in the mixture if a good job is wanted. I find that many masons want to be too free with the lime, and I forgot to say that in this job it looks as though the hair were thrown in free, as in places it sticks out like hair on a dog.

Don't use too much lime. Use plenty of cement. Use coarse sand in first coat. Push well through the lath. Keep work well sprayed with water until hard. Spray well before putting on second coat, also any other coats that may be applied. I don't approve of two-coat work, but on cheap jobs, people will have it. I think it is best to have no less than three coats.

Another very important matter is the measuring. I find many people use the shovel to measure with. This is all guess work, as no two men will measure alike. A bottomless box to hold just the amount of what sand it is expected to use in each batch with a sack of cement is a handy thing. In measuring lime I generally find a pail of about the right size. Now another very important part of stucco work is to have help enough on the job so that when stopping or starting the work, there are no places to show, but always finish to a corner or up to some window or door frame, as it is very hard to make a neat appearing "splice" in between night and morning work.

LEWIS T. HOWE.
North Weymouth, Mass.

Suggestion for Poured Concrete House to Cost $3,000

The accompanying illustrations serve as a suggestion for a poured concrete house. The design is by William C. Lurkey, Buffalo, N. Y., and was awarded second prize in a contest conducted recently by the Blaw Steel Construction Co.

The house is figured to cost $3,000 and is described in brief as follows:

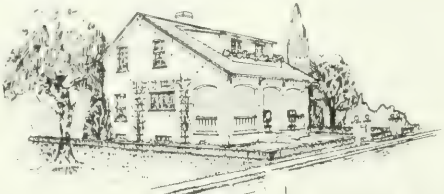
The outer walls and porch posts are to be of monolithic concrete construction; cellar and porch floors to be concrete, porch floor to be marked off into 8"x8" squares as shown on plan. Outer concrete walls are to be 6" thick, reinforced with ¼" vertical and horizontal rods 18" apart, furred on inside with wood furring strips and plastered. Cellar under kitchen, dining and living rooms. Walls to be 12" thick. All first floor partitions 3" thick of concrete, and plastered. All inside partitions on second floor to be 2"x4" studs 20" o. c. lathed and plastered. Floor joists, 2"x10", 16" o. c. Roof rafters 2"x6"—20" o. c.

Floors to be oak in living and dining rooms; balance hard pine.

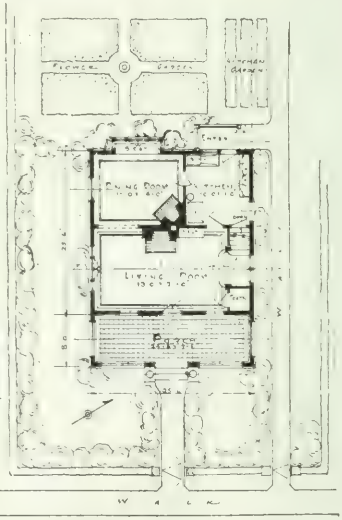
All inside trim cypress stained.

Window frames built into walls with a 2" reveal on outside and flush on inside; all exterior trim to be cypress stained a dark brown; sash of white pine painted. Chimney to be lined with flue tile built into concrete. Soil and vent pipes built into walls.

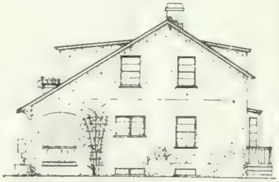
Roof shingled with red asbestos shingles.



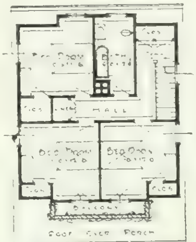
PERSPECTIVE



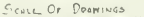
FIRST FLOOR PLAN

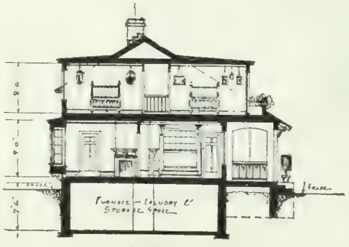


SIDE ELEVATION



SECOND FLOOR PLAN





SECTIONAL VIEW

PERSPECTIVE, PLANS AND ELEVATIONS OF CONCRETE HOUSE

A Test Beam Equipment*

One of the most important problems in reinforced concrete building construction is the accurate and economical testing of the material used for the structure. It is very desirable to determine the strength of the concrete in lbs. per sq. in., or in other words, the resistance of which the material is capable up to the point of its destruction. The common method used in most cases has been to make test cubes or cylinders and have them tested in a testing machine. The disadvantages are many. Aside from the excessive expense of tests at a testing station, and the time lost in sending samples, there is the added fact that the results are not so reliable and acurate as might be expected. The effort to find some substitute for the direct compression test, which can be used in connection with a testing laboratory only, has led to the development of an improved testing machine design, operation and efficiency of which are described in the following notes. Since this machine, which is made by Buchheim & Heister, Frankfurt, A. M., Germany, allows tests for both tensile and compressive stresses to be made, it considerably simplifies the testing problem. It determines the variations in the quality of the bonding agent in the concrete, and indicates clearly the quality of the aggregates, like gravel, sand, rubble, etc. Since the disadvantages of direct compression test are eliminated, a test of a series of 3 "control" beams is sufficient, especially as the simultaneous tensile and compression test allows an excellent determinating of the entire series of tests. The light weight of the machine, as well as its simple construction, permits its use at the building under construction, and eliminates the need for specialized operators.

It is well known that the tensile strength of stone and concrete is much below their compressive strength, and a simple concrete beam tested in flexure would therefore give an indication of the tensile strength only. This draw-

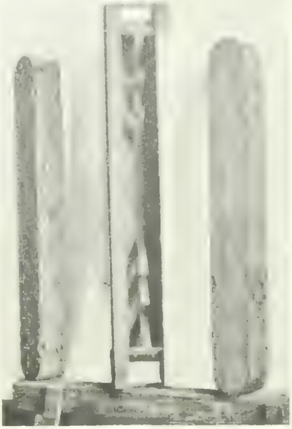


Fig. 1—The Steel Form With Wooden Side Pieces for the Test Beam is Shown in the Center. At the Left a Specimen of Poor Concrete; at the Right, One of Good Concrete

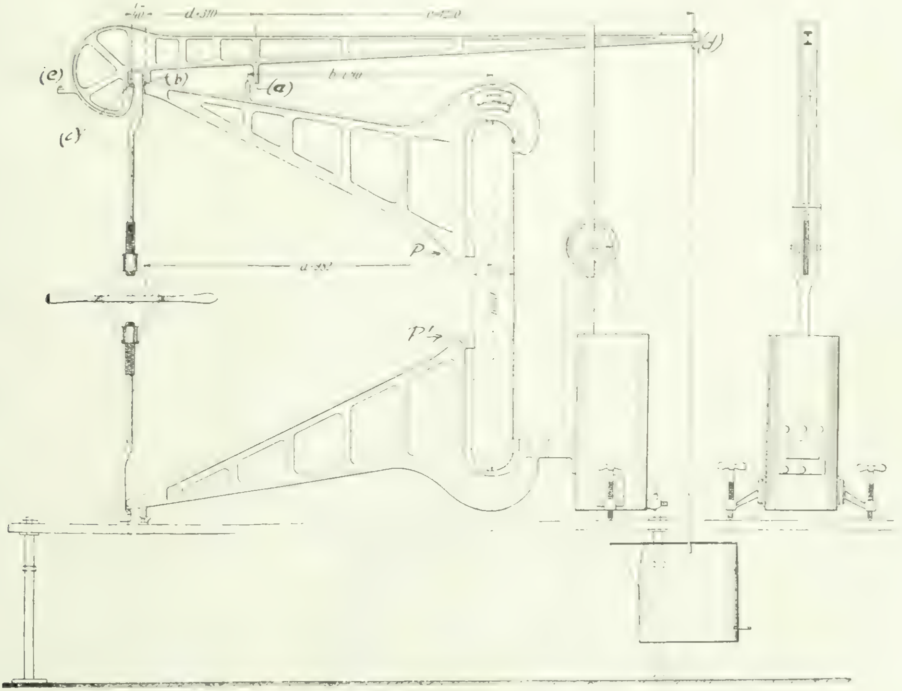


Fig. 2—Diagram Elevation Showing the Essential Features of the Test Beam Equipment

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*[Note:—The "control beam" as developed by Dr. Von Emperger, was described in detail in *Cement Age* for November, 1911. Later details on its use in the construction of the War Department building, Vienna, Austria, were published in the same journal, February, 1912. The possible adoption of this "control beam" to American practice has been discussed in the Correspondence Department of *Cement Age* for November and December, 1911, and January, February, March and June, 1912. The "improved" test beam, referred to here, was described briefly in *Cement Age* for June.

Efforts have long been made to replace tension and compression tests with flexure or bending tests. In Information-Consultation Department, December, Page 89, flexure testing equipment was described. The equipment and methods described are of value in advancing knowledge and experience along this line.—Editors.]

back can be eliminated by reinforcing the tensile zone with steel rods, and thus develop such tensile resistance that the compressive zone becomes the weak point of the beam. Up to the present the test beams used have been reinforced with ordinary steel rods, which had to be placed very accurately, a very difficult problem under unfavorable conditions, as encountered in building construction. The improved test beam uses band irons instead, which are bent to a semi-circular loop at either end. This band serves also as a form and determines the width of the specimen, usually 10 cm., (4"). Two side boards with iron rims, 12 cm., (4.8") in height, set up flush against the band iron serving as bottom, complete the mold, the different parts of which are held in position by iron clamps. After the beam has been tested, the concrete is loosened from the band iron reinforcement by a few light blows of a hammer, leaving the band iron ready to be used again for another test beam. Any quality of concrete can be tested. This testing equipment, it is claimed, will test concrete up to 430 kg. sq. cm. (6,106 lbs. per sq. in.), which is sufficient for all ordinary purposes. If greater strengths are to be determined, the width of the beam can be reduced to 7 cm. (2.8"), allowing tests up to 600 kg. sq. cm. (8,520 lbs. per sq. in.), which is sufficient for any concrete. This width can be used to good advantage in testing bricks or lime sandstone, as the width of the latter is usually about 6.5 cm. (2.6"), thus fitting snugly within the beam mold. The brick or stone specimen is placed in the central portion of the machine, and concrete filled in at either end. If the steel reinforcement is to be tested, the steel mold is not used. Instead, 2 10x12 cm. (4"x4.8") wooden head pieces are clamped between the sides of the beam mold, to keep the proper distance between the mold sides, and the steel rods are used for reinforcement.

It is often necessary to test odd concrete pieces taken from different parts of the building, and this can be done by cutting the concrete to size so as to fit into the mold, and then filling the cracks and crevices between mold and test piece with a rich mortar.

It is seen that this machine can test beams for tensile as well as compressive strengths. All that is necessary is to reverse the beam in the machine so that the concrete is brought into tension. The advantage of the reform beam is that the same beam can be tested first for tensile strength, and then for compression. The form of the band mold holds the two parts of the beam broken in the tensile test so closely ogether that they can be used for the compression test with sufficiently accurate results. Extensive tests have shown that a preliminary tensile test has no influence whatever upon the accuracy of the compression test. The possibility of testing the same beam for both tensile strength and compression simplifies testing and adds an excellent check to the test, which cannot be obtained in any other method of concrete control.

The Testing Machine and Its Operation

We come now to the description of the testing machine, and it will be noted at the first glance that the beams are tested in an upright position, instead of the usual horizontal position. This arrangement alone reduces the external forces necessary for the tests by 1/6th. As Fig. 1 shows, there are an upper and a lower lever arm, joined by a rod, whose length can be shortened by means of a hand wheel. This is practically a turn-buckle rod. In order to be able to measure the force exerted by the lever arms, the connecting rod does not act directly upon the upper lever arm, but indirectly only, acting through the agency of a balancing lever. The tension exerted upon the upper lever arm is indicated at the extreme end of the balancing lever, reduced to 1/40th of its real magnitude. An aluminum vessel is suspended from this extreme end. This vessel or pail receives the water serving as counterweight or ballast, coming from a small reservoir connected with the extreme end of the lower lever arm, and flowing into the aluminum pail, after a cock has been opened. This steady flow of water acts as a uniformly increasing load upon the long end of the balancing lever arm. The hand wheel at the shorter end of the lever arm is therefore to be turned in such a way as to increase the load upon the shorter arm to an extent which will always balance the load on the longer arm of the balancing lever.

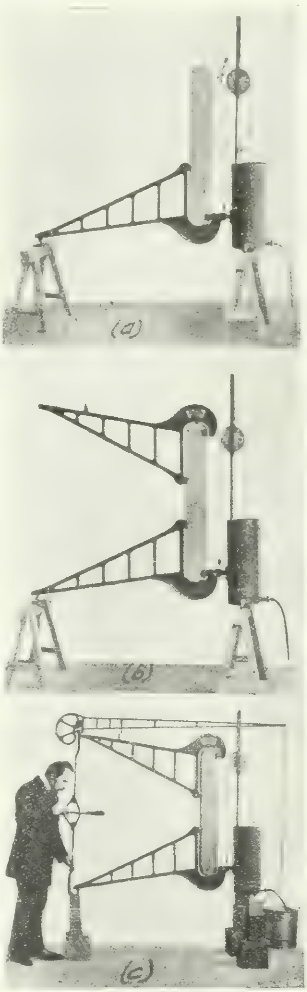


Fig. 3—The Different Stages in Assembling and Operating the Test Beam Equipment

This problem is very easy as long as the beam is still subjected to a strain without breaking. As soon as failure occurs, however, the movement, multiplied by 40, is felt at the long end of the balancing lever, with the result that it is impossible to keep the balancing lever in equilibrium. Its front end will drop, and will instantly arrest the indicating device, so that the compressive or tensile strength at failure, as the case may be, is plainly indicated, without the necessity of stopping the flow of water into the pail.

This indicating device consists of a metal disc, rotating vertically on ball bearings, and connected with a graduated dial. A copper float in the aluminum vessel is attached to a nickel plated counterweight, by a fine, very pliable copper wire running over the disc as shown in Fig. 2. This float and counterweight communicate every change of water level in the vessel to the dial, so that the graduated dial shows the quantity of the water in the pail at any time. Each degree on the dial corresponds to a 1 kg. (2.2 lbs.) of water.

Above the disc a metal rod is balanced, which does not interfere with the rotation of the disc and dial, so long as the test is going on. At failure, however, where the long balancing lever arm drops, the metal rod drops also, and arrests the further rotation of the disc. The entire indicating device is merely set upon the reservoir attached to the extreme end of the lower lever arm, and is fastened there by the turn of a screw.

The entire testing machine is set upon two blocks 50 c. m. (12") high or bricks, if necessary, and is ready for work. The levers are made of a special alloy, designed to stand the most severe tests. The connecting rods are of steel, and the edges of the lever arms of nickel plated steel. No iron parts are used, and there is no danger of corrosion. The entire apparatus complete weighs only 180 kg. (396 lbs.).

Different Capacities: Reference to Fig. 2 will show that two pairs of knife-edge bearings (*a* and *b*) between the balancing lever and the upper member allow the machine to be adapted readily to different loadings. It will be readily seen that if the balancing lever were raised and moved to the left using the bearings at *a* instead of at *b* (as shown in Fig. 2) the force exerted on the test beam at *p* would be much less than the force exerted when the machine is adjusted as in Fig. 2. Such an adjustment would be used when testing concrete in tension. For concrete in compression, or steel in tension, the adjustment shown in Fig. 2 is used.

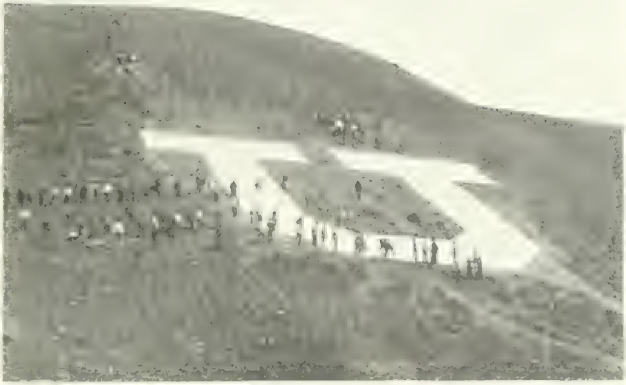
In assembling the machine the lower lever arm with attached reservoir is placed upon two wooden horses or other supports, about 2 ft. from the ground. Then the test beam is placed upright into the lower lever socket, and the upper lever arm adjusted to the other end of the beam, as shown in Fig. 3.

Then the indicating device is fastened to the reservoir, and the latter filled with water. The float will rise, while the counterweight will sink. The indicating dial should show the zero position, and a rubber tube is attached to the cock at the reservoir, and led into the pail. Then the balancing lever is adjusted, and the pail suspended from its longer arm by a wire. (Fig. 3, c). The extreme end of the balancing lever arm should balance freely above the indicating device before the test is made. When the beam breaks, the balancing lever arm drops, the indicating device is stopped and the result can be read off.

After completing the tensile test, the apparatus is taken apart, and the beam is turned around so that the steel mold faces the reservoir, while previously it faced the connecting rod. Then the machine is put together again and the same test repeated, this time for compression. however. As a rule a series of three beams is used for one test. One person only is needed for making the test, since no part weighs more than 15 kg. (33 lbs.) and the test beam of 28-30 kg. (61-66 lbs.) weight can be handled easily by one person The indicator reads from 0 to 14.5, each of these numbers corresponding to a certain load, which is recorded in tables furnished with the testing machine. The results can be recorded on blanks and formulas and kept for future reference. The key to the strengths indicated by the machine can be kept at the engineering office and used there, thus keeping the knowledge of the exact results from undesirable parties, and assuring the secrecy which is at times necessary.

This testing machine does not, it is claimed, exert any shearing forces upon the cross-section of the beams to be tested, but normal bending forces only. Every machine is carefully tested and calibrated before being sent out. An iron beam is used for test beam, and it may be interesting to note that the design of the machine is such that the load of the auxiliary weight plus the weight of 14 litres (854 cu. in.) of water results in a moment which is equivalent to a direct load upon the beam of 9,000 kg. (19,800 lbs.), which is the rated capacity of the machine.

The Northern Pacific Ry. Co. is building a semi-circular concrete tunnel 25′ in diameter and 87′ long under Tacoma Ave. at South 28th St., Tacoma, Wash.



[illegible]

A College Shrine in Concrete

BY HAROLD GOFF

A unique piece of work in concrete is the official initial of the University of Utah—a gigantic letter "U" on the mountainside northeast of Salt Lake City, above the campus of the state institution. The letter is said to be the largest initial in the world. On clear days it can be seen from the farthest point of Salt Lake valley, a distance of 20 miles. To tourists entering Salt Lake from the south it is one of the first objects of interest.

As originally constructed in the spring of 1905, the "U" was made of lime obtained from an abandoned kiln in the vicinity. Energetic sophomores of the University having placed their class numerals 40′ high on the mountainside, their collegiate enemies, the freshmen, felt obligated to erase the numerals and replace them with the freshman symbol. Then followed one of the most vigorous class fights that have marked the history of the Utah school. Day and night, for nearly a week, the contest went on intermittently, and each morning residents of Salt Lake would go out upon their porches to see which class had succeeded in leaving its mark upon the mountain.

Finally a armistice was arranged, in the course of which a long-headed student suggested that the combatants combine with the upper classmen and construct a mighty "U" as an emblem of loyalty to the whole school. Accordingly, on an appropriate morning, the male contingent of the student body assembled and formed a bucket line from the old lime kiln to the site of the proposed letter, 1,000′ distant, where some of the engineering students had marked an outline. The "U" that emerged from the hillside was not a perfect one, but it was there, dazzling white against the purple gray of the hills. By the time the spring of 1906 came the "U" was a sorry looking affair. The snows and rains had washed most of the lime away so that it needed refilling. A petition for a half-holiday was granted by the faculty of the school and the work of reconstruction was begun. A larger official block "U" was laid out, the original letter having been of the script variety. Two hundred buckets were kept in motion for nearly six hours along the 1,000-ft. line, more than 5,000 bucketfuls of lime being spread over the letter. In the spring of 1907 the students again saw the necessity of straightening up their "U." It was apparent, however, that this would have to be an annual occurrence if lime continued to be the material used. Arrangements were made, therefore, to replace the lime with concrete. The old initial was destroyed, excavations were made and forms put in for a concrete "U" 4″ deep.

The letter as it was constructed then and as it now stands, measures 100′ across the top bars and is 100′ high. The bars are 20′ x 45′, with a space of 10′ between them. The sides are 15′ wide and the bottom 20′, making a total area of 4,750 sq. ft. Thirty-seven loads of sand, 40 of gravel, and 12 of water, together with 200 sacks of cement, were used in the construction. There are 1,583 cu. ft. of concrete in the letter, weighing about 120 tons. As the letter lies on a slope of 40% grade, the task of building it was no small one, and the university students are proud of the fact that they did it all themselves.

Report of Test of Reinforced Concrete Column

At the recent convention of the N. A. C. U., a trip was made to the Pittsburgh laboratories of the U. S. Bureau of Standards, which was of interest particularly because of the test to destruction of a large reinforced concrete column.

Concrete for this column was made in the proportion of 1 volume of Universal Portland cement, 2 of Allegheny river sand, and 4 of "Ligonier" crushed stone, mixed to a wet consistency. The reinforcement was medium grade steel and consisted of 7 1-1/16-in. round vertical rods, and a ½-in. wire spiral with a 3-in. pitch. The special reinforcement consisted of 31 flat spirals of No. 5 wire of three turns, spaced vertically 6" c. to c., as shown in Fig. 1.

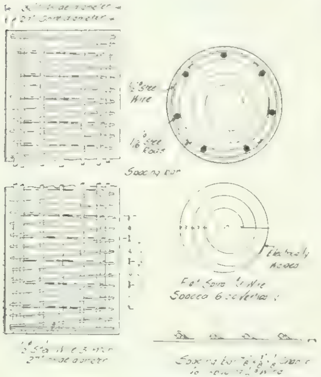


Fig. 1—Detail Showing Flat Spirals Used as Horizontal Reinforcement

The column was cast by U. S. Bureau of Standards, Nov. 18, 1912, and was tested when 25 days old.

Dimensions of Column

Length o. to o.	16' 0"	
Outside diameter	30"	
Core diameter	27"	
Core area	572.55	sq. in.
Total cross sectional area	706.86	sq. in.
Total area of vertical steel rods	6.2	sq. in.
Percentage of vertical steel to core area	1.08%	
Cross sectional area of helix per foot of column	.784	sq. in.
Volume of concrete	78.56	cu. ft.
Volume of steel	1.53	cu. ft.
Weight of steel:		
Flat spirals	51 lbs.	
Helix	318 lbs.	
Verticals and spacers	382 lbs.	
	751	lbs.
Weight of concrete column	11,784	lbs.

For this test, the 10,000,000-lb. compression machine was used. During the test, the column shortened approximately 5 ins. and deflected about 5 ins. laterally. The vertical rods were 4" shorter than the original length of the column, but after the test it was found that the ends of a number of rods were within ⅛" of the end of the column, showing that the concrete core had been compressed considerably.

A careful examination of the column after the test, shown in Fig. 2, indicates that the exterior shell of concrete, ¾" thick, peeled off under the load, showing that this concrete did not act with the concrete of the core, and should not be considered as part of the column in figuring strength values.

It was apparent that the failure was caused by local buckling of the vertical rods near the top of the column, bearing against and rupturing the ½-in. hooping. The total load sustained was 1,950,000 lbs. or approximately 3,400 lbs. per sq. in.

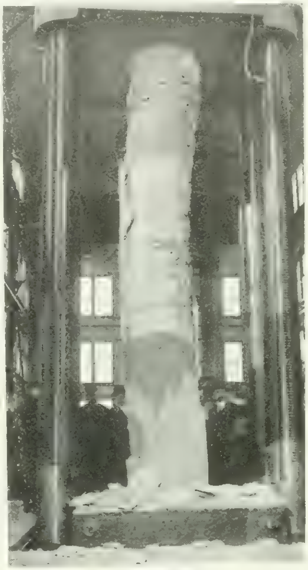


Fig. 2—The Column at Failure

From previous tests on similar concrete it may be assumed that the value of this concrete, at 25 days, when exposed to ordinary atmospheric conditions, as was the case with this column, would be about 1,400 lbs. per sq. in., which would indicate that the column should fail at 800,000 lbs. Compression was apparent in the fire-proofing before this load was reached, indicating that the concrete of the core and that of the fire-proofing were not acting together.

The vertical spacing bars that held the hooping uniformly spaced buckled between the hoops. No doubt the action of the flat spirals considerably increased the ultimate load. An examination of the concrete within the core after the test showed that it was still "green" but had become quite broken up at the point of failure. The column was designed by R. A. Cummings,[1] and the reinforcement fabricated to his design by The Electric Welding Co., Pittsburgh.

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[1] Consult. Eng., Pittsburgh

Details of a Simple Equipment for Grouting

It is practically impossible to build a concrete tunnel of any length that will not develop leaks. The Illinois Tunnel Co., Chicago, took every precaution to overcome the temperature stresses and natural conditions of the soft strata underlying Chicago, but new crevices show up almost every day in some part of the 300 miles of trackage. Wm. H. Haynes, in charge of the repair work, found that the leaks developed in an erratic manner, oftentimes at opposite ends of the system on the same day. The machine used to patch these leaks was heavy, requiring the united efforts of six or eight men to move it from one place to another and set it up for work again. Most of the time of the men was spent in this task. He believed that a smaller unit could be made and in 1910 set about the task of designing one. To the top and bottom of a rectangular 5-gal. tin can he soldered valves, and pouring about two gals. of grout into the can, proceeded to pump air through the valve on the top. A large bicycle pump was used and the contrivance was given a trial. In those places where the soil behind the walls was soft, a sufficient pressure to force out the grouting could be obtained, but in many cases the pressure was too low. This machine is shown in *A* of Fig. 1.

Two cans were then connected together and packed in a case, tape being wound about them. A larger pump operated with a 4-ft. lever was secured and a satisfactory pressure was easily attained. The only draw-backs to the new device were that the cans would not last very long and it took several minutes to pump enough air to raise the pressure. Their principal advantage was in the lightness, as one man could easily carry the outfit from place to place by strapping it on his back, and he could do as much work with it as six men could with the large machine.

In order to secure durability the tanks must be made of heavier material and a more powerful pump must be used. This necessarily increases the weight to at least 400 lbs. and Mr. Haynes built his third model, the one now in use, on the trucks of one of the company's cars.

Two cylindrical 5½-gal. capacity tanks, capable of withstanding a pressure of 150 lbs. are used, one for grouting and one for air storage. A power air pump, operated by a 2 h. p. Western Electric series motor, raises the pressure in the air tank to 120 lbs. in 1¼ mins.

In operating, a hose is attached to the bottom of the grouting tank and the loose end is carefully packed with oakum in a hole bored through the wall that is leaking. A mix of equal parts of water and Portland cement is made, and 2½ gals. poured into the tank. "Chicago AA" (Chicago Portland Cement Co.) was used. Meanwhile the series motor is connected through the trolley and rails and the pressure in the air tank is raised to 100 lbs. The pump is then stopped and the valve at the bottom of the grouting tank opened and the air is turned in on the grout.

When the air has forced the grouting into the space between the walls and the earth, the hose is cut off short and the opening carefully packed with oakum. A trowel of cement covers the scar and the entire job is complete in less than ten minutes.

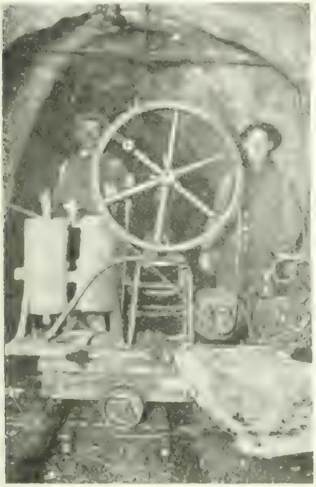

Fig. 2—A Flashlight of the Grouting Machine at Work

With the exception of the grouting tank the machine rarely requires any renewals. The tanks cost $1.84 each and last about one year, making this expense negligible. Of course, it is impossible to carry such a machine about by hand, but it is small enough to be operated in any part of the bore and can be taken on the elevators, and a motor car will draw it from one end of the system to another in a half hour. Less than a minute is required to get the machine ready for action. The original cost is small and the upkeep is comparatively nothing.

The pump is belted to the motor and raises the pressure in the near tank to about 120 lbs. The other cylinder is filled about half full of cement grout and the hose is thrust through the hole bored in the leaking wall. The pressure is turned in on the grouting and almost instantly the whole mass is forced into a thin space between the wall and the earth. The hose can be seen entering the wall on the left. Wm. H. Haynes is standing at the right.

It is, in general, not advisable for any contractor to use the gravity system for the first time on a job of less than 2,500 cu. yds. However, it has been successfully used on jobs as low as 250 cu. yds. In these cases, the apparatus was on hand and the men were acquainted with its operation.

Concrete Pressure Pipe

Arthur P. Davis, in a paper before the N. A. C. U., states that a comparatively recent development which has been extensively used by the Reclamation Service is the manufacture of reinforced concrete pipe for use under pressure and for conserving the water supply. A large number of pressure pipes have been used for crossing depressions and also to serve as drops to carry water to lower elevations without destructive erosion. One pressure pipe 46″ in diameter and over 10,000′ in length, has been in use on the Umatilla Project about two years. The major portion of this pipe is under 110-ft. static head and no perceptible leakage has occurred. Similar results with lesser heads have been obtained in numerous instances and in no case has concrete pipe used by the Reclamation Service proved unsatisfactory. In the earlier experiments it was deemed best to build the pipe continuously so as to avoid joints, but of late years the major portion of pipe used, especially in the smaller diameters, has been manufactured in lengths of from 3′ to 8′ at some yard established where materials are convenient and hauled to the point of use and laid in trenches. The joints are sealed with cement mortar and very satisfactory results obtained.

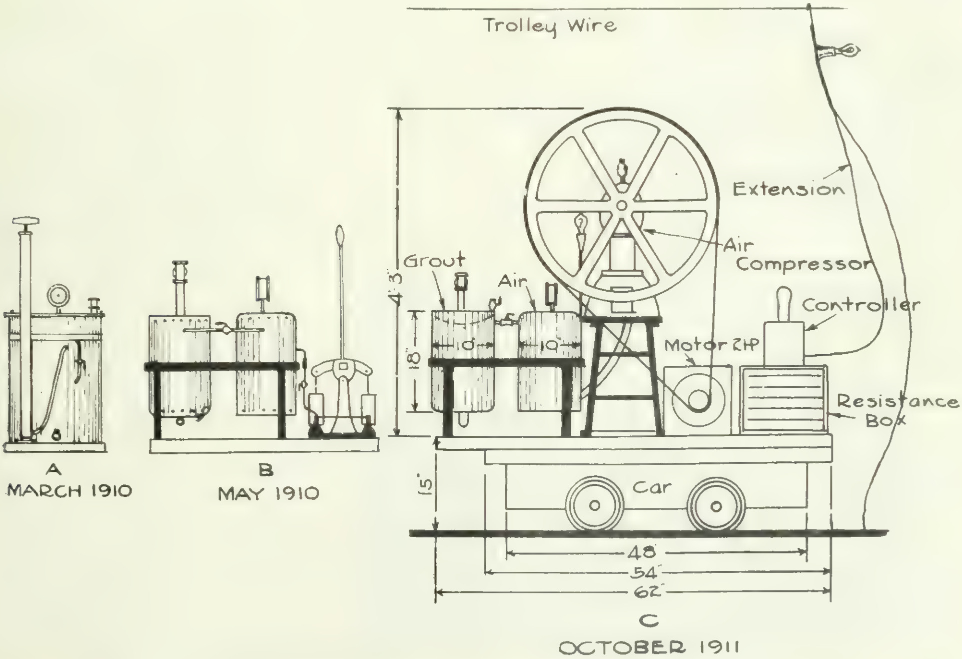

Fig. 1—Sketches Showing the Evolution of the Grouting Machine

Concrete Manure Pits Readily Built at Moderate Cost

Every farmer knows the great value of barnyard manure as compared with other fertilizers and he also knows, or should know, that much of it is wasted when piled in the open or stored in sheds or pens. When left in the open manure deteriorates in fertilizing properties and is washed away by rain.

Stored in sheds or pens, heating or "firing" takes place through lack of moisture. The remedy for these conditions has come with the advent of the concrete manure pit.

The concrete pit when properly made is waterproof, thus insuring the proper degree of moisture and also the preservation of liquid manure that formerly ran to waste.

Will a concrete pit pay?

The answer is that from 30% to 40% of the strength of manure is wasted under the extravagant practices described above. Government experts have estimated that one load of manure stored in a concrete pit is worth from 1½ to 2 loads of manure cared for in the ordinary way. This is a large percentage in favor of the concrete pit.

It is comparatively easy to handle manure from the pit and especially so when liquid manure is needed for the garden or truck patch. It can be pumped from a sump hole made at one end of the pit for that purpose.

In a majority of cases farmers will probably find the shallow manure pit the most convenient and practical. The cross-sectional drawing (Fig. 1) shows the type of construction. These pits are especially convenient when manure is hauled to the fields frequently. They should be constructed as follows:

The walls and floor are 5" thick. The clear dimensions of the pit are: Depth, 3'; width, 6'; length, 12'. Dig a pit 3' 5" x 6' 10" x 12' 10". By keeping the sides vertical an inside form only will be needed. Frame the sides and ends separately. For the sides cut 1-in. siding 12' long and nail it to four 2-in. x 4-in. uprights 3' long and equally spaced. The end uprights for the sides are 2" x 4" nailed flat to the siding; the others are also 2" x 4" but are nailed on edge. It is not necessary to cut these uprights to exact lengths; they may be allowed to extend above the siding. Make the siding for the end sections of the form 5' 2" long and at the ends nail it to the edges of two 2-in. x 4-in. uprights. Place a single 2-in. x 4-in. upright between each end pair. Cut four cross braces, 5" to 10" long, from 2-in. x 4-in. timbers. Have enough sections of woven-wire fencing, 7' 6" long, to cover the bottom of the pit.

The concrete should be a mixture consisting of 1 bag of Portland cement to 4 cu. ft. of pit gravel or 1 bag of Portland cement, 2 cu. ft. of sand and 4 cu. ft. of crushed stone. Crosswise, tamp in a section of concrete (not too wet) 2" thick and a little wider than the strip of woven-wire fencing used as reinforcing. Lay the wire with an even division of the extra length, so that it may project upward into the side walls. Tamp in the remaining 3" of concrete. Work rapidly and complete the floor. No facing mortar is needed.

Immediately set up the forms on the finished floor so as to allow a 5-in. wall on all sides. Join them by nailing together the 2 by 4's at the corners of the sides and ends. Do not drive the nails home. Cross-brace with 2 by 4's and with 1-in. boards from each central end upright to the second side upright.

Quickly begin filling the forms with concrete almost wet enough to pour, and keep it practically the same height on all sides. Puddle the concrete by running a long paddle up and down next to the form. Do not punch the earthen wall. Dirt in the concrete may make a poor wall. If the top of the earthen wall tends to crumble, hold it back with 1-in. boards braced against the forms. To keep out flood water, the pit may be extended 6" above the ground by using the lower half of a 1-ft. board to hold back the dirt, and by allowing the remainder to project above the ground level, and by adding 6" to the height of the inside form. Remove the forms after the concrete has set four days by first drawing the nails in the corner 2 by 4's. The pit may be used after 10 days.

Where manure must be stored for a considerable length of time, larger pits or basins are required. Such pits are seldom made more than 5' deep (in the clear at the deeper end) and are wide enough that the manure may be loaded on a spreader in the pit and drawn up a roughened concrete incline or run. The slope for such a run must not be steeper than 1' up to 4' out.

In building such a basin as planned in Fig. 2, use a team with a plow and scraper to make an earthen pit in which to build a concrete basin of the clear dimensions shown. In laying out the earthen pit, bear in mind that the concrete walls and floor are 8" thick and make due allowance. With a spade trim the sides and the deep end vertically.

In order to form a sump hole from which the liquid manure can be pumped, in one corner at the deep end of the pit dig a circular hole 18" deep by 2' 6" in diameter. To protect the concrete floor, at the upper end of the driveway excavate a trench 8" wide and 2' deep for a concrete foundation apron. Extend it around the corners and slope it upward to meet the driveway incline.

In general, the framing of the forms is similar to that of shallow pits. If the earthe nwalls stand firm, an insdie form only will be needed. Otherwise, build an outer form. For the forms use 1-in. siding on 2-in. x 4-in. studding spaced 2' 8". These uprights need not be cut to exact lengths. Save lumber by allowing the uprights to extend above the siding. Stiffen each section of the form by nailing a 2-in. x 4-in. scantling to the uprights at top and the bottom of the forms.

Erect the forms in the pit. Set them on 8-in. concrete blocks or bricks, so that the floor may be built under them. To prevent bulging, cross-brace the forms with 2-in. x 4-in. timbers. Begin filling with concrete, as for shallow manure pits.

Lay the floor for the bottom and the incline the same as for shallow pits.

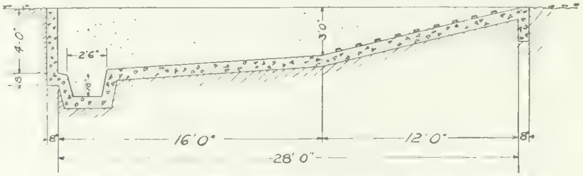

Fig. 1.—Cross Sectional Drawing of Shallow Concrete Manure Pit

Fig. 2—Large Type of Concrete Manure Pit, Pump Shows at Left Hand Side of Pit

To give teams a sure footing on the incline, embed in the concrete the turned-up ends of iron cleats bent at right angles, similar to a capital U. Old wagon tires, cut in lengths not greater than 20" and turned up 4" at either end, will do. Leave 1" clearance between the cleats and the concrete, and set them so as not to obstruct the wheelway. Space the cleats 14" to 16". Roughen or corrugate the bottom crosswise every 6" by using a 5-ft. length of 2-in. x 4-in. scantling beveled lengthwise to the shape of a carpenter's chisel. To make the corrugations, set the timber with the beveled face toward the incline. Strike the 2 by 4 with a heavy hammer, so as to indent the concrete to the depth of an inch.

If a shed roof is required, insert in the top of the concrete walls while still soft, several ½-in. bolts, which should project about 2½ in. above the wall, to which the roof timbering or cover may be fastened.

The Position of the Reinforcing Steel

In concrete work, it is essential that the reinforcing steel be accurately placed, and held in position during the operation of pouring the concrete. E. P. Wells, in his presidential address before the Concrete Institute, London, calls attention to the fact that it is a difficult matter to get the steel placed accurately, owing to the carelessness of the British workman. He suggests that the reinforcing steel after it is all placed, and before the concrete is poured, must be carefully inspected by the engineer or his representative. Mr. Wells continues the discussion as follows:

> In a great many years of practical experience I have come to this conclusion, that even if there is a large deficiency of steel in the structure both in tension and compression, and the concrete is of an excellent quality, there is hardly any chance of failure taking place, but if the steel is up to and even in excess of the requirements asked for, and by any chance the concrete be poor, then if an excessive load be placed upon the structure there is nothing to prevent its failing.
>
> A series of experiments that I carried out some years ago with some beams gave, when tested at 33 days, a factor of safety of 5¼ to 1; in three years the factor was over 9 to 1. The whole of this was due entirely to a very good concrete which was absolutely homogeneous throughout. When the beams broke they failed at the center only. There was no sign of shear, and the diameters of the rods where the failure took place were, to all intents and purposes, the same diameters as when they were put in. These experiments, I think, simply show an enormous increase in the lever-arm, due to the rich concrete; in fact, in the case I now mention the lever-arm was practically the total depth from the axis of the tension members to the outside of the compression member of the beam; but even this will not account wholly for the enormous load that the beams carried, as the tests produced extraordinary stresses both in the steel and also in the concrete itself.

Chicago Show Has 132 Exhibitors —Should Have More

Chicago's sixth Cement Show, held by the Cement Products Exhibition Co., opened at the Coliseum Jan. 16, last, and closed Jan. 23. One hundred thirty-two exhibitors were listed in the official directory of the company and a wide range of operation was covered by the exhibits.

As usual, the layout of the show was attractive. The general scheme of decoration was dignified and was uniform without being in any way monotonous. Most of the exhibitors made their spaces individually attractive by their displays and a bird'seye view of the show from the gallery was extremely pleasing. Conspicuous exhibits were made by the National Bureau of Standards, Washington, D. C., which occupied eight spaces, and by the Universal Portland Cement Co., with 10 well filled spaces. The exhibit of the National Bureau of Standards was practically identical with that shown at Pittsburgh in December, and attracted much attention. A larger corps of men in charge of the exhibit would have enabled more people to make inquiry and investigation regarding the interesting apparatus shown. A feature of the Universal company's exhibits was the paving "Determinator," which was shipped from Detroit and installed in the show. The pavement over which the Juggernaut traveled was made up of six sections of concrete, two of macadam and two of brick. The segments between sections were paved with creosoted wood. The apparatus was set for a 13-hr. run, estimated to be equivalent to 20 years' wear on a pavement under ordinary traffic. As a matter of fact, it ran practically without stopping, while the show was open, and the concrete pavement appeared wholly undamaged. This result, in a comparatively green pavement was most gratifying as a practical demonstration of concrete's good qualities for highways and pavements.

A feature of the show was the number of artistic displays of ornamental work in concrete, covering every object from garden seats to library lamps.

Practically all of the exhibits showed apparatus in operation, together with samples of the finished product. This is as it should be, since the buying public is deeply interested in the "how" of things as well as the "what." It was noticeable that the display of large machinery, which has been a feature of past shows, was lacking and a number of buyers who were in the market for big equipment were disappointed in not finding what they were looking for.

The attendance throughout the show was gratifyingly large and it was select in that it was largely made up of buyers. They came to look, to compare, and to purchase. A fair canvass of the exhibitors toward the close of the show indicated that most of them had done a good business and several of them had well-filled order books to show as the result of their week's work.

Nothing is more indicative of the cement and concrete industry than the attendance at these shows. The exhibits no longer attract the casual public, for the reason that the novelty of Portland cement and concrete has worn off. But in the years that they have been held, the shows have practically created their own public, made up of men who are active in the industry and who are numerous enough and alert enough to make a crowd of buyers of material and equipment.

Another noticeable feature of this year's show was the impressive character of some of the apparatus. It has been felt, for a long time, that the concrete building unit industry must show heavier machinery if it was to continue to grow. The addition of power to every department of manufacture except that of cast units has had a good effect on the minds of the architect and owner. In the department of cast units the manufacturers have learned that simplicity and dignity of design have the most staying qualities.

Another Chicago show is scheduled for next year. The Coliseum exhibits have become an established institution. What ought to be done at the next year's show is to have an honest effort made to adjust the differences known to exist between exhibitors of a certain class and the management of the show. The show needs these men to make it complete and the men need the show. A business-like conference on this subject, held at the present time, will result in a more representative show next year, with unquestioned benefit to the industry.

Where water is coming through concrete because of porosity, the Aberthaw Construction Co., Boston, have found that a treatment of boiled linseed oil thinned down with gasoline will do much to cure the trouble. They have built roofs which were to cover delicate instruments in fortification range finders. These roofs proved porous, but a treatment with boiled linseed and gasoline cured the trouble permanently. It is a thoroughly good treatment for porous brick walls, has the merit of being very cheap, and the materials are reasonably available, and the most ordinary laborer can apply it intelligently enough. Besides this method, paraffine can be dissolved in gasoline and applied in a similar way with good results.

There is probably nothing that can be done to make a cement floor acid proof. The treatment with the linseed oil will retard the effect of acid, and of course particularly dense concrete will deteriorate more slowly than porous concrete. Where acid is to be used it is economical to give the floors several good coats of linseed oil and gasoline, and if possible during shutdowns to repeat the operation.

Denver is planning to spend $13,772.64 in concrete paving for alleys in the outlying districts. Evidently she wants to go very cautiously.

American Highway Association Takes Stand for Federal Aid

Until the recent annual meeting of the board of directors the American Highway Association has not taken a definite stand in the matter of federal aid except by resolution at the annual road congress, in which it pledged itself to the Congressional joint committee. Its efforts have been confined principally to educational and advisory work in all the states, through the board of directors aiding in the formation of road improvement associations in the various states and municipalities and assisting in the drafting of uniform laws for highway building, maintenance and supervision.

An invitation to confer with the Joint Committee of Congress investigating the subject of federal aid with a view to determining whether or not such a system would be practicable and, if so, what form the federal aid should take undoubtedly led the board of directors of the Association to take a definite stand in the matter, and immediately following the meeting of the board the members conferred with Senator Bourne of Oregon, Chairman of the Joint Congressional Committee, and his fellow members of that committee, in response to the invitation extended some time ago.

The members of the board who were present at the annual meeting are: Logan Waller Page, president of the Association, who is also director of the United States Office of Public Roads; W. W. Finley, president of the Southern Railway, chairman of the Association's executive committee; Alfred Noble, past president of the American Society of Civil Engineers; J. M. Goodell, former editor of *Engineering Record;* George C. Diehl, chairman of the good roads board of the American Automobile Association; A. G. Batchelder, chairman of the executive committee of the American Automobile Association; George W. Cooley, state highway engineer of Minnesota; J. P. Nelson, representing the C. & O. Railway Co.; Jesse Taylor, president Ohio Good Roads Federation, and A. H. Huston, Columbus, O. The consensus of opinion was that there should be federal co-operation in highway construction and that the best results could be obtained by improving those main highways which carry the greatest volume of tonnage and serve the largest number of people with an equitable distribution of such highway improvement among the states. At the two-hour conference with the joint congressional committee the views of prominent members of the board of directors of the Association were made known and will probably have much influence on the final judgment of Congress.

The members of the board passed a resolution confirming the action of President Page in approving the employment of J. E. Pennybacker, secretary of the Association, as statistician of the Congressional committee.

Methods of Repairing Concrete Pavement

In a paper, "Methods of Repairing Cement and Concrete Pavements,"[1] Frank F. Rogers, deputy commissioner, Michigan State Highway Department, describes repairs and methods on concrete roads and pavements particularly in Michigan.

The Bellefontaine, O. concrete pavement, built in 1893 and 1894, contains 4,400 sq. yds. It was constructed with Buckeye Portland cement, a leaner mix being used in the base than in the top. The approximate total cost for repairs has been $200. This is at the rate of 4.54 cts. per sq. yd in 18 years, or an annual cost of 0.252 cts. per yd. The pavement was cut into squares, similar to those commonly seen in concrete sidewalks, and the principal part of the wear has been along the longitudinal joints thus formed. The wheels of vehicles form grooves at these places, which they have a tendency to follow.

Cement mortar or concrete has usually been used in making repairs and the material has been placed in the grooves after they have been chiseled out. Sometimes this patch has been dove-tailed in, that is, the sides of the notch incline towards the axis of the groove, rather than outwards. In some places paving bricks, laid crosswise, have been cemented into the prepared notch, instead of making the entire patch of concrete. This has been done when it was impracticable to keep traffic off the street long enough for a concrete patch to harden.

Bad Axe, Mich., population 2,500, paved its main street for a distance of ½ mile with cement concrete in 1908. Gravel taken from beneath the subgrade of the pavement was used for the aggregate. It was laid 2-course work, the base being a 1:6 mix, 5″ thick, with a wearing surface of a 1:2 mix, 2″ thick. The contractor guaranteed this street for five years, hence the city has made no repairs up to this time. Transverse joints were placed every 12′. There were no longitudinal joints, except at the gutter lines, though the pavement is from 30′ to 50′ wide. The contractor has patched a few places by chiseling out the old pavement to the subgrade and filling the excavation with 2-course concrete of the same mix used in the original construction. The transverse joints now show considerable wear, the groove, due to chipping off the edges of the adjoining slabs, being in many places 2″ deep, and very perceptible when riding over the pavement in an iron tired vehicle even at a slow speed. Similar wear is visible around the edges of some of the patches. There are also some holes which need repairing.

Pavements at Grand Ledge and Scottsville, Mich., were laid in 1910. Some limestone was used for the coarse aggregate in these pavements. Both were of 2-course work and were in need of some repairs the second year, but mostly at the joints. In neither town have the repairs received the attention that should have been given them.

The first concrete pavements in Ann Arbor were laid in 1909, but in Alpena, Lansing, Coldwater and Charlotte they were laid one and two years later and have needed but slight repairs.

The pavements at Ann Arbor and Lansing were top dressed with tar and sand, refined tar being used on all the later work. This top dressing wears off annually, particularly in the central portion of the roadway, and has to be wholly or partially renewed at a cost of from 5 cts. to 6 cts. per sq. yd.

Kalamazoo, Marquette and Red Jacket each has considerable cement concrete pavement, laid under the R. S. Blome patents. At Kalamazoo, the City Engineer states that the surface is carefully watched and all holes repaired when they are small. The holes have been thoroughly cleaned, washed with cement and filled with a 3:1 mixture of good bank gravel and Portland cement. These repairs have given good results. The pavement now shows a large number of long surface cracks with the edges wearing rapidly. The percentage of surface thus far repaired is small, but a larger pecentage will have to be repaired in the next five years. This pavement was laid in 1907 at a cost of $1.74 per sq. yd. It has a 5-in. base and 2-in. top.

Some concrete has been laid on the rural highways in the counties of Berrien, Huron, Saginaw and Wayne, but in the two former counties the roads were built in 1912 and have needed no repairs. On these roads sand and gravel were used for the aggregate in a 1:2:4 mix.

Saginaw county built its concrete road in 1910. Sand and crushed limestone were used for the aggregate. Each of the two layers is 3″ thick. The bottom is a 1:2:5 mix and the top a 1:2:4 mix. The pavement has had quite extensive repairs. The portions that have been found defective were due to a leaner mix or to a less depth than was specified. Repairs have been made by cutting out the defective places to the corrected sub-grade and filling with concrete as above specified for the top layer. No extra refinements were used in these repairs, and, so far, no trouble has been had with the places repaired. This pavement was only 9′ in the central portion of a 24-ft roadway. It carries a rather heavy mixed traffic, consisting of heavily loaded farm and trucking wagons, throughout the season, and a heavy sugar beet traffic (loads 2 to 5 tons) during the months of October and November. Repairs have been very small on the better built portions of this road.

Wayne county began building concrete roadways in the summer of 1909, and has built a larger mileage each succeeding year. The first two years 2-course concrete was built, the bottom 4½″ being a 1:2½:5 mix and the top 2″ being a 1:2:3 mix, using crushed cobblestones for the coarse aggregate in the surface layer. Since then, 1-layer concrete 8 in. thick, with a 1:2:4 and a 1:2:3 mix, has been adopted, using washed pebbles and sand for the aggregate. The richer mix was used last summer.[2]

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[1] Presented Jan. 3 before Section D, American Association for the Advancement of Science.

November 23, last, an inspection was made of the Woodward avenue concrete roadway, one mile of which was laid previous to July 1, 1909, and 1 1/5 miles of which was laid in the early part of the season of 1910. Both of these pieces are the 2-course work above referred to. These pavements are 18′ wide, and have transverse expansion joints every 25′, making 211 sections to the mile. The oldest mile has had nearly four seasons' wear and has passed through three winters. On the first mile, 9 sections show one or more pit holes, 17 sections show transverse cracks, a very few of which reach entirely across the roadway, and 61 sections show longitudinal cracks, many of which reach the whole length of the section. In fact, most of these longitudinal cracks are grouped, several contiguous sections showing cracks where there are any at all. Isolated sections showing longitudinal cracks are the exception and not the rule.

The 1 1/5-mile stretch, which has had nearly three seasons' wear and has passed through two winters, shows defects as follows: Pit holes, 8 sections; transverse cracks, 7 sections, and longitudinal cracks, 13 sections. For better comparison, it may be stated that 29 per cent of the sections showed longitudinal cracks on the first mile, while only 5 per cent of the sections showed longitudinal cracks on the second 1 1/5 miles. Roads of more recent construction show proportionately fewer defects.

Repairs to the Wayne county concrete roadways have mostly been confined to expansion joints, where the edges of the concrete have chipped off, and to the defects above described, which are subject to the same action.

In making repairs, the cracks, whether at expansion joints or other places, are broomed out clean, preferably when the weather is warm and dry, and poured full of hot refined tar. A portable heating kettle is moved along on the pavement and the tar is poured from long-nozzled cans, which are fitted with long wooden handles. When filling a joint the workman backs up, dragging the nozzle of the can along the crack, which is filled about as rapidly as a man can work. As fast as the joints are filled, another laborer follows up and spreads a layer of dry sharp sand over the tar to a depth of from ¼ in. to ½ in. Pit holes, unless large, are filled with tar and sand in the same manner. It might be added that the tars are found to adhere to concrete better than the asphalts.

Repairs of this kind cost about $50 a mile and have to be repeated each year They prevent further deterioration of the pavement, both at the transverse joints and at the cracks which nature has formed. In fact, so far, the cracks do not seem to menace the life of the pavement.

In a few places where holes have formed, due to defective mixing or to some foreign substance accidentally getting into the concrete, repairs have been made by chiseling out the concrete down to the subgrade, brooming off the sides and filling the excavation with concrete of the same kind as used in the original construction. The cost of this kind of repairs has been a negligible quantity, as compared with the others.

The transverse joints on the early construction were formed by placing three strips of tar paper between the 25-ft. sections. Later, sheared steel plates, separated by strips of tar paper, and having prongs which are bedded in the concrete of the adjoining sections, have been used. So far, there has been little or no chipping of the edges of the concrete next to the steel plates. However, the joints are all kept filled and covered with tar and sand to prevent possible wear.

On two roads which were completed late in the fall, short sections of the surface became thickly pitted to the depth of ¼ in. to ½ in., due to opening the road to traffic before the concrete was thoroughly hard. These defects have also been repaired by covering the entire surface of the pavement with refined tar and coating with sand, as in the case of the joints and cracks. This coating has to be renewed when it wears away.

A few sections of the Michigan avenue road, not in need of repair, were tarred and sanded in 1911 to watch results. Only a small part of this was worn off the first year, but so far, the kind of repairs already described are all that the Wayne County Road Commissioners have found necessary or advisable.

Where trucking is particularly severe, paper mills as a rule use either steel or cast iron plates embedded in the finish or attached by lugs down to the top. In a recent investigation the Aberthaw Construction Co., Boston, has found that a perforated cast iron plate embedded in the finish gives the most satisfactory wearing surface of any of these. Peforated plates are sometimes embedded in the floors at the time they are laid.

A ¼-in. plate is often used for covering the floor which is subject to hard trucking. This has the disadvantage of cracking up the edges and making an irregular floor Rolling truck wheels on the surface tends to expand this surface. As a result of this, it will be found that if the plate is lug-bolted down to the floor, near its center, the edges will tend to cling to the floor instead of cocking up.

The Use of Motor Trucks in Heavy Contracting

A contract to haul about 10,000 tons of cement, reinforcing steel and general merchandise from Keddie, Cal., to the site of a dam at Big Meadows, which is being constructed by the Great Western Power Co., besides moving out approximately 100,000,000 ft. of lumber was taken by R. H. Croninger, of the Speedwell Motor Truck and Service Co., San Francisco, Cal. The Service company is under bond and the roads over which the work is being done are practically nothing more than mountain trails, widened out to make it possible to operate trucks. Of the work accomplished, Mr. Croninger writes as follows:

In going into the matter to handle this freight, I found out that the average cost of hauling it over this road by horse-drawn teams was, about 58 cts. per ton mile. It took the teams four days to make the round trip, and the approximate load carried per animal was 1,200 lbs., which soon dropped down to 800 lbs. the months of July and August. We are doing this same work for about 9 cts. per ton mile, this price absorbing additional drivers, helpers and mechanics.

The Power company was paying last season an average of $13 per ton. The Service company is taking the same contract for $2 per ton, hauling from Keddie to the dam and $2 a ton hauling lumber from the dam to Keddie. Speedwell trucks make this round trip in 12 hrs., carrying full capacity, including the time of loading and unloading. I figure that the six 6-ton trucks have displaced about 270 horses and 40 drivers.

In leaving Keddie the trucks pass over two summits, each averaging 5,400′. They have one pull of nearly three miles which averages 9%. The steepest grade encountered is a very short one of about 18%, leaving Shoo Fly Bridge. The road is very steep and the turns very sharp.

Handling the cement was not a difficult task, as we were able to get a full load in about 12 min., unloading in 7 min., but we had about 700 tons of 30-ft. length reinforcing steel, which was most difficult to handle.

It might be interesting to note here that the facilities for loading cement were most modern and unique. The cement was taken from the freight car and dropped in a chute which empties down in the cement house; the floor of the cement house was just even with the top of the side boards on the trucks and enabled three men to load from 120 to 130 sacks in 12 min. At the dam the cement was usually dropped in a chute, a distance of about 300′ down the canyon to the mixer house, or, if the mixers were not working, it was thrown in a cement shed.

The trucks were originally fitted with rollers, in the bottom of the body for handling lumber, but, after some experience we found it impossible to use these rollers, owing to the fact that the roads were so rough, so we could not bind the lumber as a unit to make the rollers effective.

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[2] The Board of County Road Commissioners report using a 1:1½:3 mix on 1912 work. See CONCRETE-CEMENT AGE, Sept., 1912, p. 86.—EDITORS.

The greatest difficulty we experienced was with tires. In checking carefully our report for the month of June I find that exactly, out of 100% hours efficiency, 94% of the time lost was due to tire trouble and 6% to mechanical troubles.

The Service company was compelled to resurface all of the bridges and in additon spend about $2,500, the county absolutely refusing to assist in any way.

The camp at Keddie is composed of about 25 men. We use two drivers and day, allowing only such time as is to a truck and operate the trucks night absolutely necessary for the truck to go through the service department to put it in first-class mechanical condition before it leaves for its next trip.

I have learned this much from this experience, that unless one is thoroughly familiar with the road conditions it would be well to be cautious about taking contracts of this kind. The continual use on the roads by the heavy trucks soon destroys the roads and puts them in almost impassable condition. The speed is necessarily slow and the tendency to mechanical trouble and tire troubles very large.

I predict that 75% of the large capacity trucks sold west of Denver in the next few years to come, will be used for similar mountain work.

The Bridgeport Hydraulic Co. recently bought two Locomobile 5-ton trucks for use in connection with an immense storage dam, which is in process of construction at Easton, Conn. They were installed to haul heavy supplies such as cement, coal and machinery from the railroad at Bridgeport, a distance of 7 miles, to the site of the dam. This furnished a most severe test, as the roads were particularly bad, being hilly and having many soft stretches where the mud was almost axle deep.

Almost from the time the trucks leave the city line of Bridgeport, they traverse a soft, heavy road, leading over a series of eight or 10 steep hills. The dam is located at the summit of one of these. In the four months from the time these trucks first supplanted the horse drawn equipment, each truck had run up a mileage of about 5,000 miles, and in each case they were called upon to carry capacity loads.

When these trucks were first placed in the service of the Bridgeport Hydraulic Co. the schedule called for four trips a day each, which far excelled the best results obtainable from the horse drawn wagons, but their efficiency has now been largely increased, owing to the fact that five trips per day are made, five tons being the standard load.

Before buying these trucks, the company, in an effort to obtain absolute figures as to the horse transportation, had some coal delivered in a horse drawn wagon. On the day of the test it was found that this four horse team was able to make two trips with a 4-ton load, but it was realized that this was a record which could not be kept up every day.

Using these figures as a basis of comparison in order to avoid any danger of making the cost per ton mile with the horse drawn vehicle too high, and charging $3.50 per day per team of horses and $2.00 a day for the driver, a very low charge, the cost of transporting two 4-ton loads 7 miles, a total of 56 ton miles, would be $ .1607 per ton mile. With the trucks making four trips a day, carrying a 5-ton load, a total of 140 ton miles and allowing $15.00 a day to cover all charges on the truck, the cost per ton mile was only $ .1071.

On the basis of five trips per day to the dam, carrying a load of 5 tons, the truck shows a total of 175 ton miles. Allowing $18.00 for all truck charges the cost per ton mile is only $ .1029 which, as compared to $ .1607 per ton mile for the horse driven team, would seem to indicate, in no uncertain terms, the economy of the large capacity motor truck.

Although the item does not appear on the books and, consequently, cannot be credited in any way, the use of the trucks has saved the Bridgeport company a good many dollars, through avoiding the necessity of cutting down a hill, a proposition which was seriously considered while the horse equipment was being used.

These trucks are soon to be used in hauling 48-in. iron pipe to the site of the dam. Each of these pipes is 13′ long and weighs 5 tons. One will be carried on a truck and another on a trailer on each trip.

Some recent tests of LaFrance gasoline hydraulic trucks used with trailers in hauling heavy loads should be interesting to contractors and dealers in building supplies.

Van Keuren & Son, contractors, Jersey City, N. J., recently loaded a truck with 6 tons and trailer with 13 tons of paving brick. A run was made from the Central railroad station at West Side avenue, and up Grant avenue to Bergen avenue over a grade which varies from 7½% to more than 10%. The truck stopped once in the middle of a hill and had no difficulty in starting again. The weight of the truck was 4½ tons and that of the trailer about the same, so that the total load was 28 tons.

In writing of further tests, Morris R. Machol, of the Hydraulic Truck Sales Co., says that trailers should be cross-yoked so that when the front wheels turn one way, the rear wheels will turn the other, because in this way only can a trailer be made accurately to track or follow the truck, and unless it will follow accurately it cannot possibly be used in city traffic. Mr. Machol has used a trailer manufactured by the Buffalo Pitts Co., Buffalo, N. Y. In another test with the truck and trailer a run of 31 miles was made. This time the load did not happen to be of building materials, but the results are just as interesting. The load on the truck consisted of 60 half barrels of beer, total weight 12,000 lbs., and the load on the trailer consisted of 96 half barrels, weight 19,200 lbs., and 81 quarter barrels, weight 8,100 lbs., or a total load of 27,300 lbs. The weight of the truck was 4½ tons and that of the trailer 8,700 lbs., so that the total weight of truck and load was 10½ tons and the trailer and load 17½ tons. It is explained that the only reason that a bigger load was not put on the trailer was because more couldn't be made to stick on. In this run the speed did not exceed about 6 miles per hour and the total run in the first two hours was 12 miles with one stop. Gasoline consumption was approximately ½ gal. per mile.

Plans Must Be Signed

The Los Angeles building department, in order to have better control over plans, the matter of granting permits and the inspection of construction, has adopted a new rule as follows:

Signing Plans for Reinforced Concrete Buildings—All plans and specifications, as well as details, schedule of loads for columns, beams, joists, girders, etc., for any reinforced concrete building or structure filed with the building department for a building permit must bear the approval and signature of a licensed architect, as provided by Section 175, Ordinance 19,90 (New Series). Approval and signed tracings, so that blue prints will exhibit signature of a licensed architect, will be deemed to conform to the provisions of the ordinance, but plans with printed or stamped names of architects will not be accepted for filing.

Motor Truck and Trailer Which Pulled 28 Tons

Damp-proofing Masonry Structures*

It is a simple physical law that fluids and gases when mixed together or confined in a vessel arrange themselves according to their specific gravities, the heavier on the bottom. This is shown if different colored oils and water are mixed together in a glass; in a short while they separate into layers according to their respective specific gravities. If a test-tube is filled with water and the open end placed in a bowl containing water with a layer of oil on it, and the test-tube is raised so that the open end is partly in the water and partly in the oil, it will be found that the water will run out and will be replaced with oil, due to the fact that water is of higher specific gravity than oil. The experiment shows up better if the water is colored with methylene blue. Circulation of the same character takes place if dry air is used instead of oil and cooler, damp air instead of water. This is shown plainly in Fig. 1.

Moisture in masonry is due to four different causes:

(1) Construction water, i. e., water used in mortar, plaster, concrete or other building materials.

(2) Condensation due to differences in temperature between the air and the masonry.

(3) Infiltration due to defects in the roof, flooding of streets or breaks in water piping.

(4) Capillary forces conveying water from the ground. The first cause is of a temporary nature and the moisture is generally eliminated before the dwellings are occupied, condensation can be lessened through rational heating and ventilation, infiltration is purely accidental and can be reduced to a minimum by proper precautions, but moisture due to capillary forces is always present and must be guarded against.

The common method of meeting the difficulty is to damp-proof the outside of the foundation, but where this is not possible, in the case of old buildings, the method herein described may be found useful. Another method employed is to prevent the water rising in the masonry by separating the foundation from the superstructure by means of an impenetrable, isolating film of glass, zinc, lead, asphalt, cement, or similar substance, but this method has the drawback of confining the moisture to the substructure, and being impossible of application to existing structures.

A new method developed by Achille Knapen, Belgian engineer, consists in placing porous hollow bricks in an inclined position as shown in Fig. 2, and developing a condition of moisture flow as discussed above and illustrated in Fig. 1. Moisture in the masonry is conducted by means of the capillary forces to this brick and there evaporated on the walls of the circular hole. This not only makes the air damper but cooler, because the heat necessary for evaporation of the water is taken from it. If the velocity of the circulating air in the brick is about 6″ per sec. not less than 350 cu. ft. of air travels up and down the brick in one day.

It is necessary to select the right dimension of the hole in the brick. Diameters less than 1″ do not permit circulation because the friction loss in the hole is too large in comparison with the small difference in the specific gravities of dry and moist air. But should, on the other hand, the diameter be larger than 1½″ the circulation would be so violent that the ingoing and outgoing air would mix, thus preventing the continuous escape of the moist air. The size of the hole, therefore, should be between 1″ and 1½″, the exact dimension depending largely upon the porosity of the brick. Of equal importance also is the inclination, which must permit the free circulation of air through the whole length of the brick and not only in front. To protect the opening from being clogged it is covered with a small wire grating.

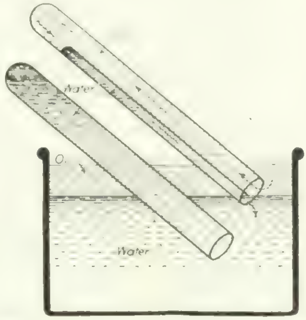

Fig. 1—Fluid Circulation Illustrated by Test Tubes Inverted Over Oil and Water

Bricks of this kind are placed in rows above each other and must not be too far apart. The area of action is of circular shape and its diameter varies from five times to 11 times the diameter of the hole. The areas of action of adjacent bricks must overlap so as to prevent the moisture from rising between them. It is found that the hollow bricks must extend somewhat further than the middle of the wall. For very heavy masonry it is found that 2′ 6″ to 3′ walls will suffice. The time necessary to dry an old wall depends upon its thickness, and varies from 30 days to 150 days.

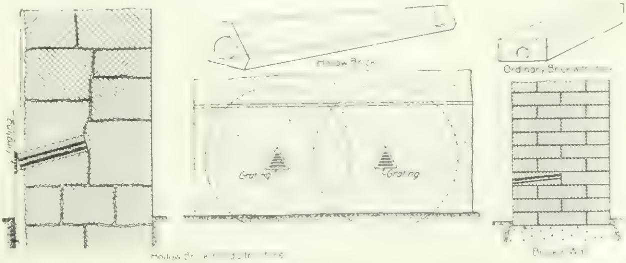

Fig. 2—Using Hollow Bricks in Brick and Stone Masonry Walls
For concrete work a similar unit could probably be made of concrete

The Work of Educating Skilled Labor in England

A great deal has been done by the London County Council School of Building in educating clerks of the works and others as to the method in which the practical part of reinforced concrete construction should be carried out. In his presidential address before the Concrete Institute, London, E. P. Wells says that they ought to go a step lower and take in hand laborers who are connected with the carrying out of the work, because until such time as they themselves understand, to even a very slight extent, what is required of them, so long will they be careless in doing the work they have to do.

The foremen employed must be instructed to keep a sharp look-out on all their men, and not to allow laxity in any shape or form. If the men know that the foreman is up to all their so-called tricks of the trade, then they will take good care that the work is carried out in an efficient manner; but if by any chance the foreman is careless, his workmen will be the same; and it will, Mr. Wells thinks, very often be found that where anything serious takes place it is not only the men but the foremen and even the clerk of the works on the job who are answerable for this state of affairs. Works executed abroad, as a rule, are carried out by men who seem to take a great interest in their work. Even the ordinary laborer knows what he has to do and does it, while in England there are so many instances of scamping, not only in reinforced work but also in other branches of structural engineering, that it is only strict supervision in the past that practically made our work some of the best in the world.

Chehalis, Wash., built 13,510 sq. yds. of concrete pavement last year at an approximate cost of $15.000.

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*From "Preventing Dampness in Masonry," in the *Engineering Record*, Jan. 18.

Concrete Block—An Architect's View

[illegible] from page 66)

great many inexperienced men to employ methods that effect a saving in cost to the detriment of the product, in consequence of which vast quantities of improperly made blocks have been placed upon the market and used by others, equally inexperienced and deaf to every call but that of the Almighty Dollar, in erecting buildings that have proven to be damp and ugly. In order to quench the abnormal thirst of this dry block a kill-or-cure remedy was evolved in the form of a facing of a more dense mixture applied to the block and fashioned to imitate quarried stone. This monotonous and hideous mask sounded the death knell to the prospect of building up an industry of any great proportions. But it also set in motion the minds of men more experienced in the properties of cement and concrete, with the result that within a year or two there has appeared for building construction a concrete block, in substance as well as in name, that gives promise of being extensively used, not only to receive a covering of stucco, but to face the world with its own individuality. This block, better described as a concrete hollow tile, is made of wet concrete composed of the proper proportions of cement, sand and gravel, with sufficient water added to enable it, when placed in the molds and subjected to a process that accelerates the setting of the cement, to acquire the properties of concrete and yet be removed from the dies with great rapidity. This new concrete product is true and even in form, light in weight, strong and durable, and apparently holds a stucco finish with permanency. The smooth and unusually large air cells afford a greater degree of attempted insulation against cold than is true of either the terra cotta block or the dry-process block, and, because of its density, far greater weatherproof qualities. It is cheaper to make, and, because of its lightness and its true and even surface, it is easier and cheaper to erect than a heavy block or an irregular terra cotta tile; moreover, as the concrete tile is laid on its bed there is a minimum loss of mortar and a greater assurance of tight joints. When the joints are neatly pointed, the wall presents a clean and fairly pleasing appearance that will no doubt improve when greater attention is paid to the color of the aggregates. Until then, concrete tile walls will be stuccoed. The coefficients of expansion of stucco and of concrete tile being approximately the same, the bond is not affected by changes of temperature and the stucco therefore adheres more readily than to terra cotta. For all purposes of country house construction concrete tile is fire-proof, and the proportionately large volume of air cells may overcome the necessity of furring the block to keep out dampness from percolation and condensation. Experiments to this end are being made, to the writer's knowledge, but a satisfactory test of the ability of this block to overcome the requirement of furring has not been made at the time this book goes to press. Altogether it is a very promising building material, and while time may uncover certain defects these will no doubt be quickly remedied, for the underlying principle of construction in this block is a good one.

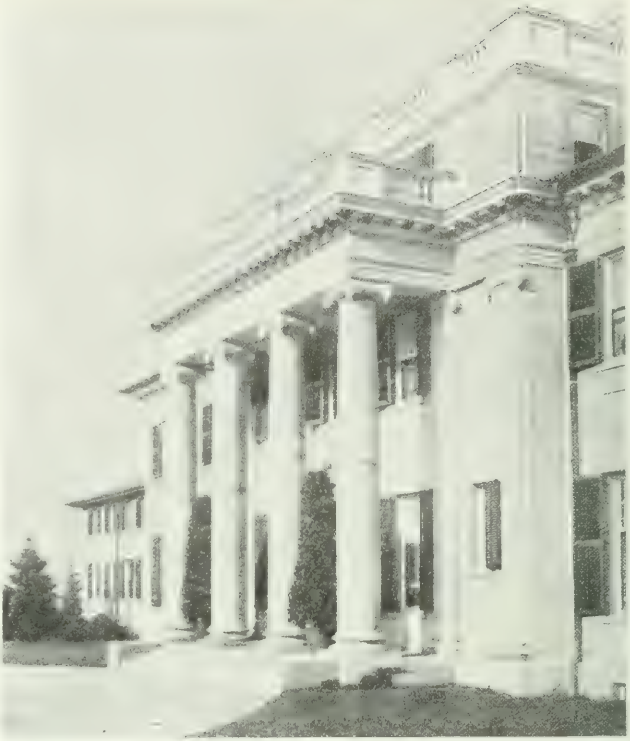


Fig. 3—Residence of I. Rich Steers, Port Chester, N. Y., Blake and Butler, Architects
"Concrete must always look like stone, because it is stone. But concrete is not quarried, and so it should never be made to imitate a rock-faced quarried stone"

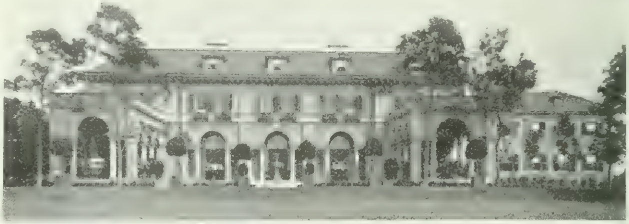


Fig 4—Residence of E. S. Harkness, New London, Conn., Lord and Hewlett, Architects
"No one can question the beauty of the proportions of this building nor the admirable effect obtained here by the use of the unveneered concrete block"

In the New London house illustrated herewith the blocks were made on the premises, of a size suited to the proportions of the building, 9" x 24", and surfaced with a carefully selected aggregate of coarse gravel pressed into a fairly wet mixture. After initial set the face was gently scrubbed, exposing

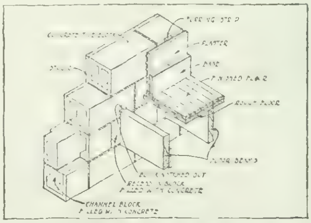


Fig. 5—A Wall of Concrete Block with Wooden Floor Beams and Floors—a Construction Which is not Fireproof.

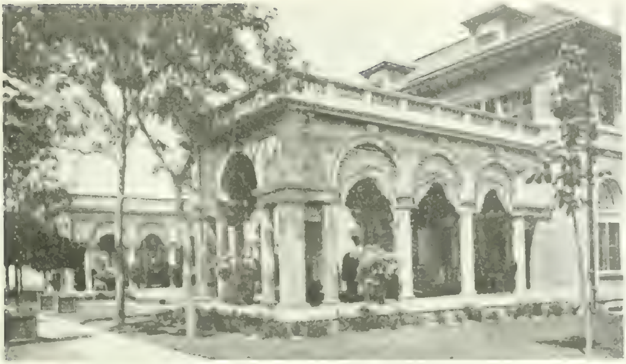


Fig 6—Residence of E. S. Harkness, New London, Conn. Lord and Hewlett, Architects
"In the New London house the blocks were made on the premises and surfaced with a carefully selected aggregate of [illegible] gravel pressed into a fairly wet mixture

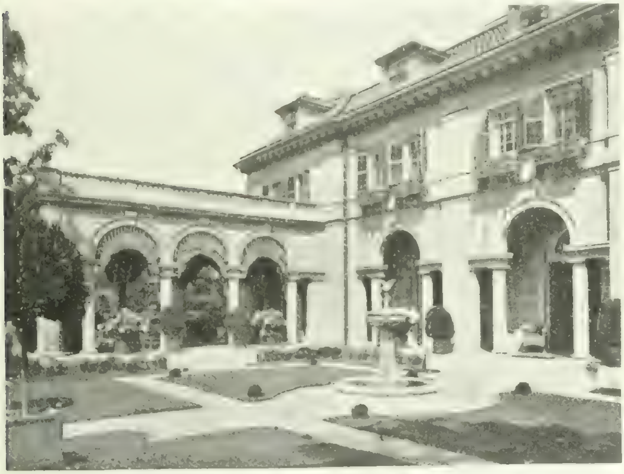


Fig 7—Another View of the Residence of E. S. Harkness
"When properly mixed and formed concrete is the most sanitary and durable of all building materials and is susceptible of great beauty when care and judgment are exercised in the selection of aggregate of suitable size and agreeable color."

the aggregate, and the blocks were given frequent sprinklings and then allowed to "season" for ten days. A clever ruse was employed to overcome the crude appearance of the arris at the joints by slightly projecting the face of the block to within about an inch of the joint, thus accentuating each block with interesting shadows. No one can question the beauty of the proportions of this building, nor the admirable effect obtained here by the use of the unveneered concrete block. Before it is generally employed by architects, the concrete block must be made of a dense mixture, therefore durable and waterproof; it must be furnished in any size or shape required by the architect's design; and finally, it must have a pleasing aspect and not be an imitation of any stone which in appearance is unlike concrete. Concrete must always look like stone because it is stone. But concrete is not quarried, and so it should never be made to imitate a rock-face quarried stone. The concrete block should stand upon its own merits, appear what it is, and not pretend to be what it is not. The most promising surface thus far obtained is by the use of a colored aggregate from which the dull film of cement is washed with a scrubbing brush and clean water.

A Reinforced Concrete Barge in Service

A reinforced concrete barge has just been built and launched at Baltimore; although the vessel has been subjected to severe tests by bumping and pressure, such treatment as it would receive in active service, it has withstood the strains and is so far an apparent success.

This barge is 112′ long, 29′ wide and of 10′ depth, drawing when light, 4′ 9″. It has a carrying capacity of 500 tons and it will be used for the transportation of sand and gravel. It is expected that other barges of concrete will be built for general merchandise transportation, and it is hoped by its builders that this type of craft will supplant barges built of wood.

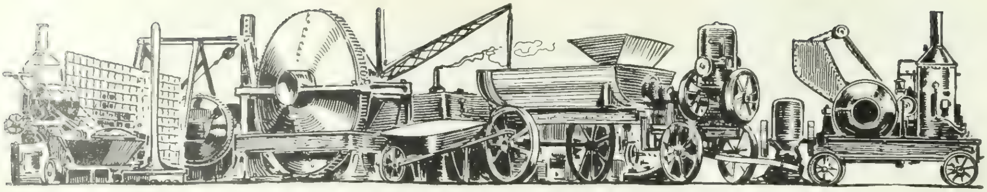
From a cost point of view the first reinforced concrete barge is much more expensive than subsequent ones would be on account of the cost of the building of the moulds, but it is stated that by using the moulds now in hand barges can be built much cheaper than of wood.

The new barge shown in the accompanying illustration, differs but little in appearance from its wooden sisters save that its corners are rounded instead of square. It has bolted to its sides and ends huge wooden timbers to act as fenders and protect its stone-like sides.

In the construction of the barge the method pursued was very similar to that of putting up of a reinforced building. To give the barge strength and at the same time add to its sea-worthiness the hull is divided into 20 compartments, to each of which entrance is gained through manholes in the deck. The side walls of the barge are 4″ thick, the ends are 6″ thick, the bottom is 6″ thick and the floor, or deck, is 3″ thick. The reinforcement consists of steel bars, ranging in diameter from ¼″ to 1⅛″ The deck is supported not only by the 6-in. walls that form the bulkheads for 20 compartments, but also by 20 6-in. x 6-in. columns, placed in the center of each compartment.

The Arundel Sand & Gravel Co., Baltimore, for whom the barge has been built is very much pleased with it so far, and its officials have said that if it will measure up to what they believe it will,—be as serviceable as, and less costly for repairs than wooden barges,—they will displace their fleet of 50 wooden vessels with the concrete craft.

A Concrete Barge Used for Sand and Gravel at Baltimore



New Equipment, Methods and Materials

In this department the Editors endeavor to keep our subscribers informed upon new tools, methods, machines and materials used in this industry. It is in no sense a department for the benefit of advertisers. To secure attention the thing described must be new to our readers. No matter will be printed simply because an advertiser desires it. Likewise, no matter will be excluded simply because the article described is not advertised in this paper. We aim to keep our readers informed—suggestions for the improvement of this department are solicited.

A Mixer With a Stationary Drum

The Enterprise Foundry Co., San Francisco, is now placing on the market the Enterprise planetary mixer for concrete, plaster, mortar, etc. Contrary to most styles of mixers, the drum remains stationary and is mounted on three standards, two provided for dumping the drum and one as an outboard bearing for the driving pulley. The whole machine is mounted on steel I-beams.

The driving pulley is mounted on the extended hub of the trunnion, driving the sprocket on the head shaft, which in turn drives the bevel gear on the center shaft. When a bottom discharge is employed and it is not necessary to dump the drum, the driving pulley is mounted directly on the head shaft.

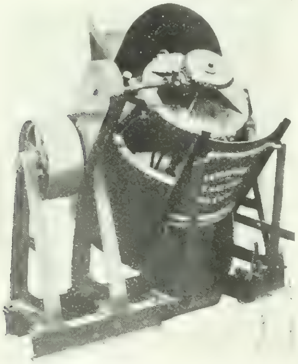


Fig. 1—Detail View of Planetary Mixer Showing Driving Mechanism and Dumping Arrangement

On the drum is mounted the head which contains an internal gear. Below the head is the yoke, carrying two supplementary vertical shafts, each shaft being fitted with a tee having two paddles. On the other end of each of these supplementary shafts, which run through the yoke, is a walking pinion, meshing with the internal gear in the head, the entire mechanism being held together and driven by the center shaft with bevel gear on top of head. The yoke contains three gears, one keyed to the center shaft and one each to the supplementary shafts, so that in applying the power to the bevel gear it rotates the center gear in the yoke, which in turn rotates the gears mounted on the supplementary shafts. This causes the tees to revolve and at the same time gives the yoke a progressive movement by means of the walking pinions on the other end of the supplementary shaft.

The paddles are so set that they wipe the sides and bottom of the drum. There are no pockets or blades in the drum in or behind which any of the material can lodge. In discharging, the foot is placed on the trigger on the right hand side of the machine (Fig. 2) and the lever on the same side pulled down, inclining the drum and causing the gate to rise and giving a complete or partial discharge as may be desired. The drum will tilt to an angle of 45° and even while in a dumping position the paddles continue revolving, forcing the material out and giving a complete discharge, at the same time wiping out the drum.

These machines are built from 20" to 50" in diameter. A 16-cu. ft. mixer is but 46" in diameter and weighs 1,900 lbs., mounted on 6-in. steel I-beams, and requires 5 h. p. to operate.

A Combination Transit and Level

In the development of concrete construction it is becoming more and more the practice to use transits and levels in laying out and checking up the work. A transit is especially useful, not only in laying out the site of the building, foundations, walls, footings, etc., but is very useful in lining up the walls. A level is very handy, not only in getting levels on footings, walls, etc., but it is not at all bad practice to check up the centering on a floor before beginning to pour the concrete. In monolithic wall work, in the experience of one of the staff of Concrete-Cement Age, a level came in very handy in checking the height of all the window frames before starting to pour the walls. The

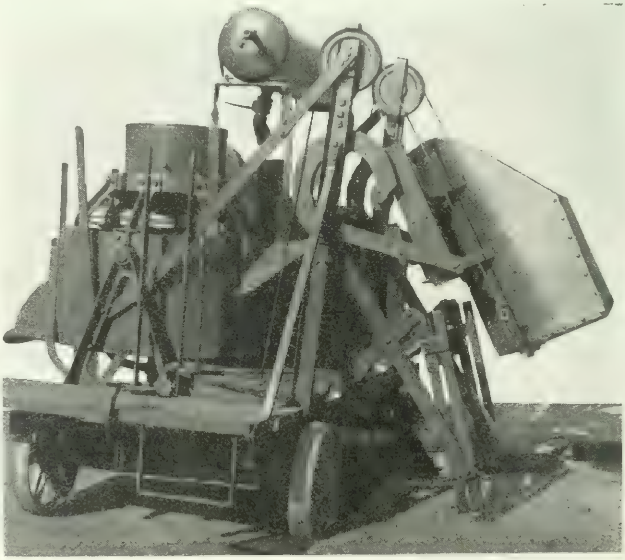
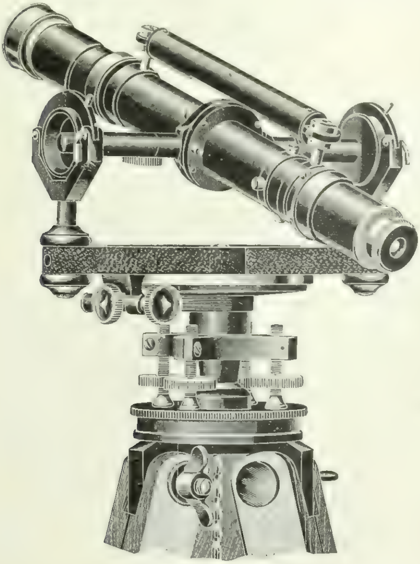


Fig. 2—A Side View of the Mixer Showing the Non-Rotating Drum and the Side Loader

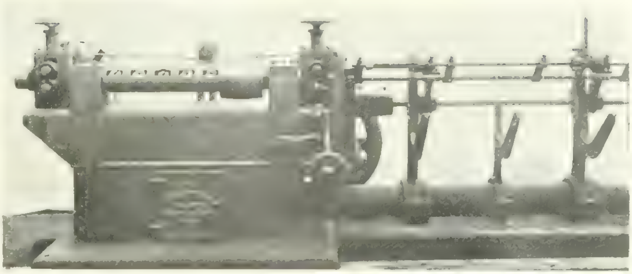
accompanying illustration shows a combination level and transit, which has been used successfully on quite a little construction work. This instrument is constructed the same as a regular architects' level except that the telescope is supplied with an adjustable ring into which the trunnions can be screwed. When the telescope is taken out of the Y's and the trunnions screwed into their respective sockets, the telescope can be tilted and the instrument used as a transit. This instrument is manufactured by Kolesch & Co., N. Y. C., who use for the Y's on this the improved locking device which is used on all their instruments.

The operation of this machine is apparent. When in use as a transit the barrel of the telescope is carried on trunnions, which are held firmly by the Y's; when used as a level the barrel is carried directly in the Y's and is in every way equivalent to a standard small sized Y-level. The base is finished in a special dull rough material, giving one the impression of a metallic felt, if it can be so described. The manufacturers have found from several years' experience that this finish, which has been developed exclusively by them, is very suitable for instruments exposed to the weather.

The Unit Construction Co., St. Louis, announces that it has acquired the interest and good-will of Ernest L. Ransome and the Ransome Engineering Co. in patents covering the Ransome Unit System of reinforced concrete construction. Mr. Ransome will co-operate with the engineering department of the Unit Construction Co. as consulting engineer



A Combination Level and Transit



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Wood Block Floors

Within the past few years wood blocks have been used to quite an extent for flooring in concrete buildings, where the wear and shock have been excessive. Probably the most notable example of this in recent work is in the new building for the Curtis Publishing Co., Philadelphia. In this building wood block flooring was adopted for all printing rooms, electrotyping rooms, warehouses and shipping rooms. The blocks used, furnished by the U. S. Wood Preserving Co., N. Y. C., in the Curtis building, are 4" deep, 4" wide and about 8" long, laid on a cement mortar cushion ½" thick. In the main building alone 30,000 sq. yds. or over six acres were used.

The printing presses used by this company are very large, but are installed directly on the wood block floors. Ordinarily it is more or less difficult to keep such large presses in alignment, but it is stated that with the wood block cushion the original alignment is permanent. There seems to be an almost total absence of vibration, due to the cushioning effects of the wood. It is significant in a way that structural concrete floor construction allows economical uses of a floor surface that is wear-resisting and as permanent as a street pavement.

The H. W. Johns-Manville Co. announces the appointment of C. S. Berry as manager of its Atlanta, Ga., office, 31½ So. Broad St. To facilitate delivery in the South, a stock of roofings, packings, pipe coverings and other J-M asbestos, magnesia and electrical products is carried at this address.

The Trussed Concrete Steel Co. has under construction a new plant in Detroit exclusively for the manufacture of its chemical products.

An Automatic Wire Straightener and Cutter

The machine shown in the accompanying illustration takes the wire from the coil, straightens it and cuts it accurately to length. It is used by reinforced concrete workers for cutting up wires for floor reinforcement and also for cutting up wires ready for coiling into spirals for columns. It is built in many sizes and of various lengths to suit the user's requirements. The longest machine ever made is one recently shipped to France, which was arranged for cutting lengths up to 67'.

The wire is placed on a suitable reel at the end of the machine, fed through the revolving head, which straightens it, out through the bush die, and into the grooved guide bar, where it strikes a gauge previously set for the desired length. At the moment it strikes this gauge, the cutting mechanism is thrown into operation, the wire is cut off, the cover of the guide bar is thrown open and the severed piece drops into the forked holders provided to receive it. It will cut up 30,000 ft. to 40,000 ft. of wire per day, depending on the sizes and lengths. The machine is built by The F. B. Shuster Co., New Haven, Conn.

The Big-an-Little Mixer

The small power-driven batch mixer is now meeting a real need in handling concrete materials economically. "Big-an-Little" is the rather suggestive name adapted by the Jaeger Machine Co., Columbus, O., to designate the small batch mixer shown in the accompanying illustration. In this mixer the drum is carried up high, driven by a run of gears around the bottom. The pan, or bottom of the drum, is of cast iron, ½" thick. The size over all is 3' 6" x 6' 6"; the largest diameter of the drum is 34", and the top of drum is 14-gauge steel plate. The frame is cast iron, and power is furnished by a standard make gasoline engine. The engine is directly under the drive shaft.

There are three interior blades or plows, and when mixing, the drum is tilted 45° toward the material. When the mixer is ready to be dumped it is turned 180° and dumps in front. Two handles are provided, so that the mixer can be dumped by a man standing at either side.

The height from ground to mouth of mixer is 40". It can be, if required, loaded and dumped from one side only,

An End View of the Big-an-Little Mixer

but the most practical way is to load from one side and dump from the other.

The rated capacity of the mixer is 1/6 cu. yd. which makes for convenient handling of materials. The weight of the mixer complete is 1,545 lbs.

Roof Construction

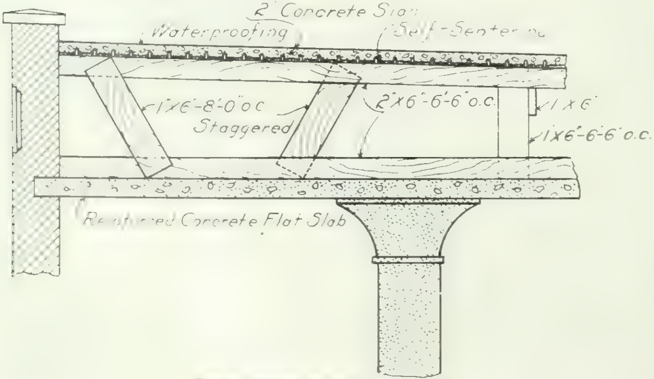
Roof construction must practically always take care of two features; there must be pitch sufficient to afford proper drainage, and there must be some insulation to keep the top story from getting too hot under the summer sun

The accompanying detail drawing shows a construction which has been used successfully on several buildings erected recently. The structural features are plainly indicated in the drawing.

The General Fireproofing Co., Youngstown, O., whose ribbed expansion metal mesh, "Self-centering," has been used in this construction, states that while no cost data are available on this exact detail, ordinary roof construction costs, including the contractor's profit, as follows:

No. 24 ga. ribbed fabric	$ 5.50 per sq. ft.
Labor erecting	1.70 per sq. ft.
2-in. Slab concrete (in place)	7.00 per sq. ft.
Waterproofing	3.75 per sq. ft.
Total	$17.95 per sq. ft.

It is stated that this is probably a little high for this class of work, as there would be no scaffolding required and the ribbed metal would be attached to wood members by staples, instead of to steel, by wire or clips, as contemplated in this estimate. The wooden framing underneath could be readily figured from details shown in the section.



Detail Section of Roof Construction

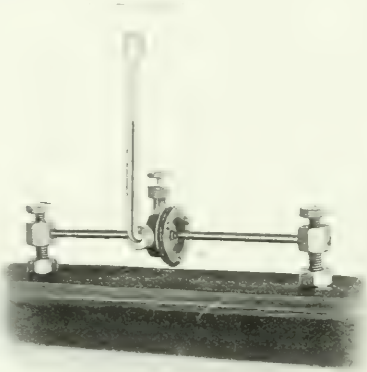
Catalogues Wanted

Duncan M. Robertson, 156 Fifth Ave., N. Y. C., is making a specialty of specification work, and is in a position to assist architects materially by writing, revising or in any way helping with specifications. He would like to receive manufacturers' catalogues and other industrial literature.

An Extensometer Using Liquid

Direct reading of deformation is at present the very general practice. Extensometers are in use and have been described in these pages in which the actual deformation is multiplied mechanically by levers, etc., for accurate reading of very small distances. The Foster Instrument Co., Letchworth, Herts, England, has developed an apparatus, a "strain-meter," as it is called, in which the actual deformation, carried on to a diaphragm-walled liquid container, produces a change in volume. This change in volume, read on the column attached to the chamber, indicates the deformation to 0.00002" (0.0005 mm.), which is closely enough for all practical work.

Operation. The illustration shows the "strain-meter" attached to a horizontal plate. It can be used equally well on vertical or inclined axes. The attachment to the plate is made by 2 ⅜-in. studs, case-hardened. The 2 studs carry rods which lie parallel to the axis of measurement. One rod carries a chamber communicating with a glass gauge tube. This chamber is closed by a flexibly mounted diaphragm, against the center of which the second rod bears. The chamber is filled with colored liquid until the latter stands at a convenient height in the graduated gauge tube. The height of the column is adjusted by means of a milled screw working through a stuffing box into the chamber.



An Extensometer of Recent English Design.

After the instrument is set up, any motion between the two points of attachment, due to change in length, will be shown to a greatly enlarged scale by the movement of the liquid in the gauge tube. Consequently, any increase or decrease of strain from the static condition when the instrument was fixed is at once read on the gauge. When bending takes place this also can be measured. The radius of curvature is seldom small enough to cause any appreciable discrepancy between the arc and the chord on the short base-length of the instrument.

Range of Measurement. In the standard pattern the multiplying ratio is about 500, the actual figure being given for each instrument. With the usual 8-in. base and on mild steel structures, this enables stresses of 13 tons per sq. in. to be measured to the nearest 1/20 of a ton. Where the stress is likely to be greater, or even to exceed the elastic limit, a shorter base, down to 2", may be used; thus all ranges of stress are easily covered.

Since the two parts of the instrument are simply in contact, no damage results if the member actually ruptures under test. For use in ordinary commercial testing machines special studs are supplied which greatly facilitate adjustment and removal.

To apply the strain-meter to concrete testing, it would be necessary to set into the member under test two nuts to receive the studs of the instrument. The instrument, with slight modification, offers a means of measuring the relative motion between a concrete mass and steel reinforcement, one stud being attached to the projecting portion of steel and the other to the adjacent part of concrete. For small specimens, such as steel rods, etc., the instrument can be attached with clamps, this eliminating any drilling.

A "Telling" Campaign for Steel Forms

To educate engineers, architects and contractors in the use of steel forms for concrete work, the Blaw Steel Construction Co., Pittsburgh, will send representatives into every town of any size in the United States and Canada to spread the "gospel" of steel forms. About 20 sales engineers in all will start from the offices in Pittsburgh, New York and Chicago. These men are instructed to call on the principal engineers and contractors in every town, tell them what steel forms have done, are doing, and can do. It is estimated that this campaign will require from 3 to 4 months' time.

Such an undertaking is sufficiently big, broad and unique to merit the interest of all concerned.

Metal Column Head Forms

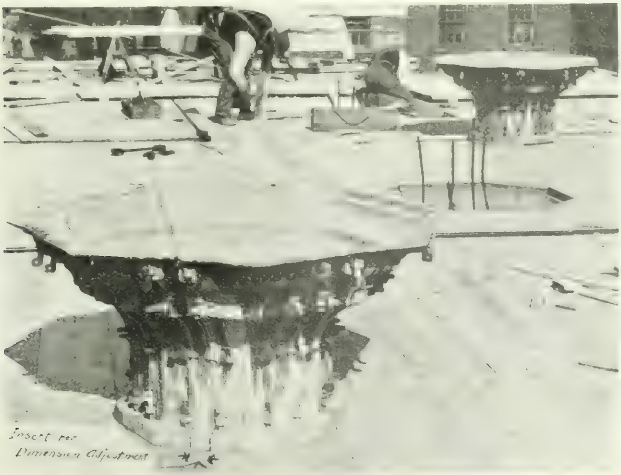
In the development of flat slab floors, the problem of the column head has been met practically from the first with the use of metal in some form. A cast iron form for an octagonal column head has been developed by the Dayton Malleable Iron Co., Dayton, O., which was used throughout the past season on several large buildings. The accompanying illustration shows this capital head being used on a new building for the Dayton Ice Cream Co., Dayton, O., Frank Hill Smith, Dayton, designing engineer.

The illustration shows the cast iron column head in detail. For the octagonal head, the form is made in 8 angular sections. The connection is simple and positive. An open extension of one section slips over an "eye" on the adjacent section and is held in place with a wedge pin. All the parts are interchangeable and can be adapted to any size column by inserting a straight-sided segment at the joint.

The cost per column of using this form has been averaged from reports sent in by contractors covering work on various buildings about as follows:

Interest and depreciation on complete column forms	$2.25
Labor, setting-up and wrecking	4.75
Total	$7.00

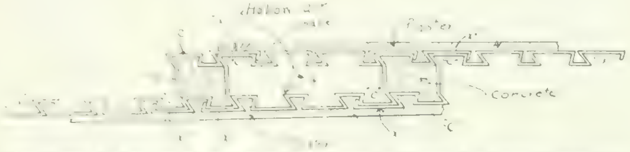
This cost is given in connection with ordinary timber forms. With sheet metal forms the cost of centering per column is approximately $9.00.



Cast Iron Column Head Forms in Concrete Floor Work

Lock Form Metal Fabric

In the Jan., 1913, issue, page 52, a new form of metal fabric manufactured by the Edwards Metal Structure Co., Kansas City, Mo. was described. This type of construction may be slightly varied and a very durable and cheap concrete structure obtained in the following manner: Instead of forming the stud member "S" midway between the ends of the section,[1] it may be formed nearer one end than the other, thus forming a narrow sheathing in one section and a wide sheathing in the other. By combining reversed sections, as shown in the accompanying drawing, the narrow sheathing members are brought opposite one another and the space or compartment formed between them and the adjacent studs can be filled with concrete to form a small concrete stud or column. The larger compartment having for its sides the wider sheathing members and the studs for its ends need not be filled with the concrete, thus effecting a saving in material. This construction will be found of particular advantage for bearing walls that do not require the heavy monolithic wall and which do need more stiffness than would be secured by using the metal stud member alone.



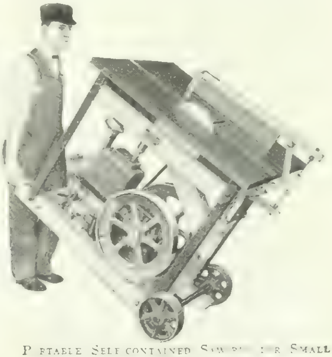
Metal Fabric So Arranged as to Provide Solid Studs and Hollow Air Spaces Alternately

The Van Expansion Bolt

The expansion bolt shown in the accompanying illustration consists of a flexible shell, made from an antimony alloy, which is stated to be rust proof, and to possess great frictional resistance. Into this fits a specially designed threaded cone of hard tough metal; grooves are formed on the exterior of the cone, which prevent its turning in the shell. The shell of the cone is capped with a tin disc which holds them together and prevents the entrance of dirt, etc.

A Portable Saw Rig

The accompanying illustrations show an ingenious saw-rig developed by the C. H. & E. Mfg. Co., Milwaukee. This saw-rig is so equipped and so balanced that it can be lifted and rolled around by one man as is shown in the illustration.



Portable Self-contained Saw-rig for Small Work

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[1] As shown in Fig. 1, page 52, the Jan., 1913, issue.

Catalogs and Other Trade Publications

Rock-Ore and Gravel Handling Machinery. T. L. Smith Co., Milwaukee, 9" x 6", paper bound, 39 pp., illustrated. The Symons rock crusher is described in detail in this catalogue. This crusher, first built in 1906, has won an enviable record for service and reliability. The catalogue also describes screens, bucket conveyors, bin gates, hoists, etc.

White Portland Cement. Sandusky Portland Cement Co., Sandusky, O., 9¼" x 7", paper bound, 32 pp., illustrated. The superiority of Portland cement as a building material is recognized. The material described in this catalogue is a true Portland cement in every particular, but its process of manufacture is such, using selected material and great care, that a pure white, stainless cement is produced. The booklet describes this material in detail, covers many of the varied uses, and shows many striking photographs of some of the most interesting work executed with this material.

Ideal Concrete Machinery. Ideal Concrete Machy. Co., South Bend, Ind., 12" x 9", paper bound, 160 pp., illustrated. The manufacture of small concrete units, such as block, sills, caps and various frame and architectural detail is becoming an established industry, and an effort is continually directed toward making the best equipment for making the best products. This catalogue describes in detail all the equipment of the Ideal Co. and sums up, in an interesting way, an extensive line of concrete machinery.

Oxy-Acetylene Apparatus. Alexander Milburn Co., Baltimore. 9½" x 6¼", paper bound, 23 pp., illustrated. The oxy-acetylene process develops intense heat by combining oxygen and acetylene gas in a blowpipe. This process was developed in France only about 10 years ago, but has had a very rapid and broad development in industrial work. The catalogue describes in detail a complete line of oxy-acetylene welding and cutting apparatus.

"The Use of Grout Mixers." Ransome Concrete Mach. Co., Dunellen, N. J., 6" x 3¼", paper bound, 16 pp., illustrated. Handling concrete with compressed air is a fascinating possibility. It is probably not generally known that grout mixers and conveyors have been used for some time on our largest engineering work. This booklet describes in detail the Ransome-Caniff grout mixer, which has been in use for some time, and is now quite extensively used.

Little Wonder Mixer. Waterloo Cement Mach Corp., Waterloo, Ia. A folder 21½" x 14". The small batch mixer has met a real demand in the field. In this folder are shown the essential details of the "Little Wonder" mixer. Hand mixing is rapidly becoming a lost art, and these small batch mixers have helped to make it so.

Piles and Poles of Concrete. R. A. Cummings, 316 4th Ave., Pittsburgh, 8½" x 6½", paper bound, 23 pp., illustrated. This is an interesting disquisition, practically an engineering essay, covering the design and manufacture of concrete piles and poles. The booklet is an epitome of several very complete papers which Mr. Cummings has presented before engineering bodies in the last few years.

Concrete Pole Bases. National Concrete Pole Base Co., Oakland, Cal., 11" x 4½",, 8 pp., paper bound, illustrated. This describes a method by which a wooden pole is anchored into a concrete base. The process described has been used in southern California. A detailed description of a test to determine the efficiency of this anchorage is presented in the booklet.

Galveston-Houston Interurban Railway. Stone & Webster Engineering Corp., Boston, paper bound, 7" x 10", 14 pp., ilustrated. This is an artistic booklet, describing in detail the great undertaking which has connected Galveston and Houston with an interurban railway. Concrete, of course, entered into this construction extensively.

Schofield-Burkett Excavator. J. C. Buckbee, Chicago, 9" x 6", paper bound, 20 pp., illustrated. Drag scraper excavators have been in extensive use for many years. This catalogue presents the essential features of the excavator developed by L. E. Burkett, Macon, Ga. The problem is covered in detail.

Steam Acetylene Generator. Alexander Milburn Co., Baltimore, 9¼" x 6¼", paper bound, 16 pp., illustrated. A recent development in the use of acetylene is an equipment by which the moisture necessary to generate the gas is applied by steam instead of liquid. This gives an extremely sensitive control over the amount of moisture used. The light is used on large work where stationary lights are needed, with steam supply available.

Collos Cement. Colloseus Cement Co., N. Y. C., 9" x 6¼", paper bound, 40 pp., illustrated. This booklet describes in detail what Collos cement is, and in general how it is manufactured It presents some interesting test data and some photographs of work where it has been successfully used. Most of the buildings shown are in Germany.

Practical Methods Applied to Modern Pavings. Equitable Asphalt Maintenance Co., Kansas City, Mo., 9¼" x 6¼", paper bound, illustrated. This catalogue describes in detail an asphalt repair plant, with which it is possible to repair asphalt by heating the pavement in place. This is done by placing over the section to be repaired or taken up, a hood into which are driven hot air and gases from the boiler. This presents points of interest to the concrete users in that it may be demonstrated that it is possible to use this same hood to heat concrete materials in cold weather.

Concrete Signboards. W. H. Filer Co., Grove City, Pa., 7½" x 5¼", paper bound, 16 pp., illustrated. This booklet describes highway signs built of concrete, in which the lettering is formed by embedding in the concrete slabs, when they are made, letters or figures, formed of cement mortar of different colors. Railroad and highway associations are investigating this method in detail.

Electric Hammers. Electro-Magnetic Tool Co., Chicago, 9" x 6", paper bound, 11 pp., illustrated. Unless steps are taken to provide for all openings in a concrete building as it is being built, it is often necessary to drill. Hand drilling concrete has been found to be very expensive, and this catalogue describes in detail an electro-magnetic hammer used for drilling. It also describes generator sets, which are used with this equipment.

Concrete Reinforcing and Furring Plates. Berger Manufacturing Co., Canton, O., 9" x 6", paper bound, 82 pp., illustrated. This booklet sums up and presents in detail a complete line of metal products developed by the Berger Mfg. Co. which can be used in connection with reinforced concrete work. "Rib-Trus" and "Ferro-Lithic" are the two materials described in most detail.

Coltrin Concrete Mixer. The Knickerbocker Co., Jackson, Mich. 48 pp., paper bound, 6" x 9". Illustrated. Continuous mixers are being used extensively on many classes of work. In the Coltrin, the mixing is done by a revolving cylinder of spiral blades, which pass under and lift up the concrete from the bottom for the entire length of the trough. The catalogue describes the Coltrin in detail.

Concrete Mixers. Schaefer Mfg. Co., Berlin, Wis. 6" x 9", paper bound, 32 pp. Illustrated. The outstanding feature of the Schaefer mixer is the direct connection between the engine and the mixing drum. The small gear that meshes with the gear on the drum is on the shaft to which the piston rod is connected. The booklet covers in detail each feature of this mixer.

Trus-Con Waterproofing Hand Book. Trussed Concrete Steel Co., Detroit. 7¾" x 5¼", paper bound, 99 pp. Illustrated. Waterproofing is a problem in practically all construction work, and this handbook covers the matter completely from several points of attack, and describes the uses of the many "Trus-Con" products in waterproofing and damp proofing.

Concrete Chimneys. General Concrete Construction Co., 431 S. Dearborn St., Chicago. 8" x 5¼", 38 pp. paper bound. Illustrated. An illustrated booklet such as this brings home with emphasis the place that concrete chimneys hold in our industrial construction today. The booklet shows concrete chimneys, built for many of our largest corporations. The subject of chimney construction is covered in detail.

Alca Lime. Charles Warner Co., Wilmington, Del. 9" x 7½", paper bound. Illustrated. "Alca" lime is composed of 15% of finely ground and pulverized calcium aluminate mixed with 85% of hydrated lime. The calcium aluminate is produced from a highly aluminous basic furnace slag, granulated by steam. This booklet describes the use of "alca" lime for stucco and ornamental work.

Gyratory Crushers. The Austin Mfg. Co., Chicago. 10½" x 7½", paper bound, 69 pp. Illustrated. This catalogue describes in detail all equipment needed for rock crushing plants, crushers, conveyors, dump cars, etc. A new motor-driven road roller is also presented.

Bridges. Wilbur J. Watson & Co., Engineers, Cleveland. 32 pp., 6½" x 9½", paper bound. Illustrated. Concrete for bridges is today the standard material, and this booklet illustrates some of the recent work of this firm.

Excavating Machinery. Union Iron Works, Hoboken, N. J. 7" x 10", paper bound, 24 pp. Illustrated. The Bishop derrick excavator is a short sub-boom carried by a traveling carriage on the main boom of the derrick, and equipped with a dipper bucket. This excavator converts any derrick into an excavator, which has been used extensively in gravel plants, dredging, building excavations, etc.

Baker Armored Concrete Pavement is the title of a 40-page booklet 6" x 9", just issued by the R. D. Baker Co., Detroit. It reports the experiences of many cities with concrete paving in which the Baker steel joints have been used. It gives comparative costs of various types of pavement in several places, thereby showing the economy of concrete in first cost as well as ultimate cost. The book also presents numerous illustrations and drawings which should be of interest to engineers and contractors on paving work, and the publication is rounded out with specifications for Baker armored concrete pavement.

Medusa White Cement in England

In Garden Village, Hull, England, 300 houses have been stuccoed with cement mortar using "Medusa"[1] white Portland cement.

Messrs. G. & T. Earle, Ltd., Hull, England, who handle this material, state that for plastering the mortar is applied about ½" thick. The first coat, mixed 1:3, using gray Portland, and ordinary sand, is applied ¼" thick. Then the finish coat, of 1:3, using "Medusa" white Portland cement and Calais sand is applied.

The rough casting is put on about 1-in. thick. The first coat, ¼" thick, is the same as the scratch coat for plastering; the second coat uses the same materials and is of about the same thickness. The third coat, put on while the second is still green, is made of 1 part of white Portland to 3 of selected pebbles.

The accompanying illustration shows a stretch of houses at Garden Village.

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[1] Sandusky Portland Cement Co., Sandusky, O.

Houses at Garden Village, Hull, Finished with White Portland Cement Made in the United States

Spouting Concrete

For successful operation of the gravity systems for conveying and distributing concrete, one of the most necessary things is proper mixing of ingredients. Having given the proper proportions to the ingredients, it is absolutely necessary that enough water be added to the conglomerate to produce a specific gravity such that the rock is held in suspension. The mixture will then flow like a thick gravy, with no sign of excess water; in other words, it sould have an amount of water sufficient to saturate and no more. This particular mixture is surprisingly slippery and flows readily around all steel. It also has almost an oily smoothness, which is due to the cement.

In placing concrete by the gravity system, there are three operations: Mixing the ingredients, stone, sand and cement, in a suitable batch mixer, hoisting the mixed concrete by skip to an elevated hopper; and transferring the concrete through pipes leading from this hopper to the point where it is desired to be poured.

The following general instructions for operating a spouting system, issued by the Chain Belt Co., Milwaukee, may be of value:

1. Run about 10 ft. of water in skip.
2. Charge mixers, using mostly sand with the cement and plenty of water.
3. Run up skip with water and drop at once, following up as quickly as possible with a charge of concrete.
4. Run the mixture so that it may have the consistency of a thick gravy, so that when it levels off the rock is seen held in suspension. If, when dumped in the skip, it stands up, it is too thick; if it levels off and shows 1" of water, it is too thin.
5. There should be a man in the tower to operate the concrete gate on the hopper to regulate the flow of concrete through the pipes. The stream should fill about ⅓ of the conveyor pipe and the charge should be so timed that the stream will be as nearly continuous as possible.
6. Continuous and successful running depends on the uniform mixture. Be careful not to get it too thin. After a shut down of over 10 min., flush the pipe by sending up 10 ft. of water in the skip.
7. At the end of the day's run, clean out the mixers with two charges of water. Send these through the pipes.
8. All pipe joints should be oiled with thick grease, so as to prevent sticking.

Waterproof Cement

Gray and white waterproofed Portland cements are manufactured by the Sandusky Portland Cement Co., Sandusky, O. They consist of "Medusa" waterproofing ground with Portland cement in the process of manufacture and form a valuable addition to the list of high-class building materials. This company is the exclusive manufacturer of both cement and waterproofing. The demand for this new product has far exceeded expectations, and it has been found necessary to install extra grinding machinery and packing apparatus to enable orders to be filled promptly.

Members of the Iowa Association of Cement Users, elected the following officers at their January convention held at Mason City:—President, Fred Wilson, Mason City; vice president, A. S. Tanner, Jefferson; second vice president, S. H. Brown, Lake View; secretary, H. H. Dean, Glenwood; treasurer, K. C. Gaynor, Sioux City. The next place of meeting will be either Des Moines or Ames.

Computing the Cost of a Concrete Silo

The following notes cover in detail the various operations necessary in building a concrete silo. These data are based on the work of John H. McCoy[1] Pittsburgh. On this work a combination steel and timber form[2] has been used, which consists essentially of curved sheet steel plates for the outside form, and wooden segmental curved panels for the inside form. The inner forms are pulled up by a pipe windlass, guided on a 4" x 4" timber, which runs through a hole cut in the horizontal timbers of the curved panel. Reference is made to this in the following notes.

For example, a concrete silo is taken, 14' inside diam., 48' 6" high and an average wall thickness of 6", with a continuous door, with removable ties across the continuous door opening.

Foundation: On ordinary well drained earth formations it has been found good practice to excavate to a depth of 4 ft. to 5 ft. below surface. This is for two reasons: first, to get below all possible freezing; second, because that part of the silo and silage 4 ft. to 5 ft. below ground is nearer the feeding trough than it is 60' over head. Excavation generally will cost 40 cts. per cu. yd., where the earth is not stony and loosened earth not too far to move. A circular pit 16' in diam. and 5' deep, to accommodate a 14-ft. inside diam. silo, requires an excavation containing about 37 cu. yds. This at 40 cts. per cu. yd. equals $15. Best practice is to construct the bottom "basin shape" and the basin should slope ½" for each foot of diameter of silo, or the center of bowl should be 7" below the rim for a 14-ft. diam. silo.

By using a concave bottom, concrete may be saved, since it need not be more than 4" to 6" in thickness, depending on nature or hardness of bottom of excavation.

Materials.—Such a silo would require 66 bbls. of Portland cement; 22 cu yds. of clean sand; 45 cu. yds. of clean, hard gravel or crushed stone; 87 pieces of twisted steel bars or any good reinforcing steel ½" x 23'; and 16 regular ¾-in. r. h. & l. h. turnbuckles, placed at 29-in. intervals.

Building Operation: The excavation must be level at every point around the wall. Little stakes are driven at intervals of 4' all the way around, and are brought to a uniform height. The circumferential stakes are 6", and the center stake 13" above the ground and all tops are on a level. Then the center stake is cut down to 6" and concrete is placed to the tops of all stakes, producing a nice basin bottom. This is about a day's work for four or five men. When the concrete is hard the inside form is set up carefully, care being taken to get it round. Then the outside adjustable form is set up and 10 or 12 boards each 7" wide of same length as height of form, say 5 ft., are secured. Next a rod or rods of reinforcing bent to the proper curvature of wall are placed, care being taken to have the rods lap at least 1' where ends of rods meet. Next the 7-in. boards are placed at spaces of about 4 ft. apart all around, to get the wall uniform in thickness. Then the mixed concrete is placed in one course all the way around, say 4 in. deep; this is repeated again and again, so as to avoid bulging any one place. When 15 ins. of concrete are placed, the spacing boards are pulled out and another rod is placed entirely around the silo and the spacing boards replaced and another 14" to 15" of concrete placed carefully, being spaded

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[1] Pres. McCoy Silo Form Co.

[2] Manufactured by the McCoy Silo Form Co., Pittsburgh.

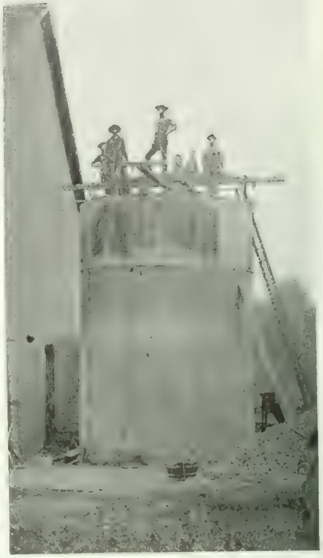

Fig. 2—Silo Construction Well Under Way

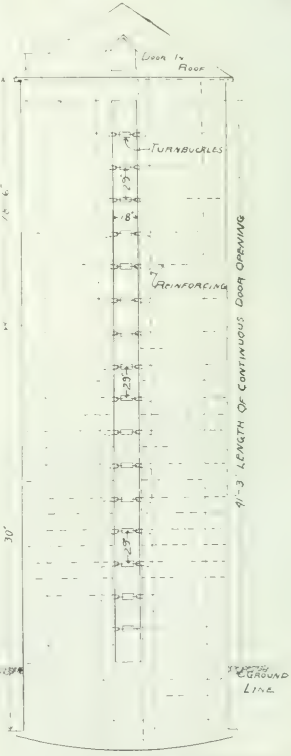

Fig. 3—Elevation of Silo Showing the Continuous Opening and the Position of the Reinforcing Steel

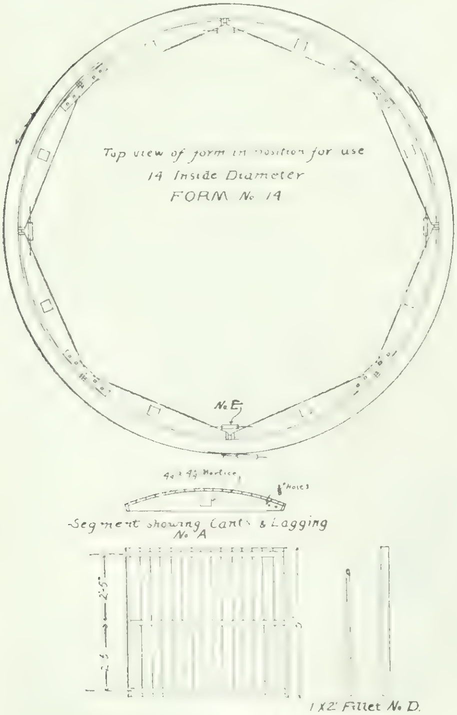

Fig. 1—Details of Form Used

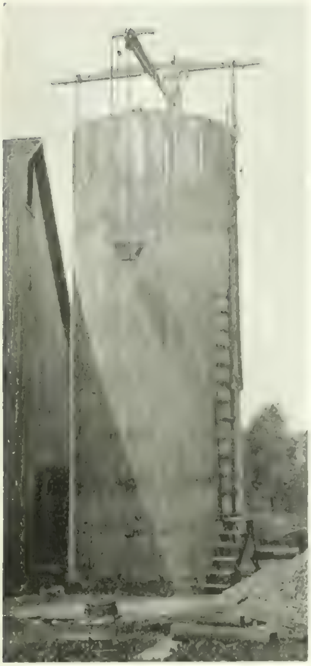

Fig. 4—The Silo Nearing Completion, Showing Method of Hoisting the Concrete

with care to work concrete in place, and to work out air bubbles. The concrete is used wet enough to run slightly. Then seven vertical steel rods, one at either side door and others to be equal distances apart, are placed followed by more curved horizontal rods and the filling process continued until form is filled. Each fill should be finished with the vertical steel projecting about 2 in. from top of concrete. The work is now at ground level, and has required a day with five men working.

On the third day two 2" x 4" timbers are nailed together to make a 4" x 4" post, which is set up vertically through the square holes in cants. The 2" x 4"'s should break joints, so as to make a strong splice. Next, the dogs are placed on the posts and windlass pipes are set up. At this time the spreaders and fillets should be removed from between forms. The inside form is shaken loose from wall, and with a man at each windlass the inside is raised, the four turning at the same time. When the proper height of 58" is reached, a fifth man will nail a short cleat under one cant on each post. Then fillets are placed and adjusted to the wall by spreaders from post to post, at fillet joints. The next step is to loosen and windlass up the outside form. This time, the spacing boards are shaved to a width of 6½", the outside form is adjusted, and the jamb forms are placed where continuous door is to be. The form is then filled with 15" of concrete, the spacing boards pulled out, and steel rods placed. Boards are placed, and concreting proceeds as before. The spacing boards are pulled out and steel rods with returned ends are placed to engage turnbuckles. The spacing boards are then replaced and 15" of concrete and two plain steel rods set. The work proceeds thus, with alternate rods with returned ends to engage turnbuckles at 29-in. intervals. The spacing boards are shaved narrower as the wall tapers. The jamb forms also should be made narrower to conform to the taper of wall as it diminishes to 5 in. or 4 in. at top of silo.

Steel—1,700 lbs. or 87 pieces ½"x23'.
Cement—66 bbls.
Sand—22 cu. yds.
Stone—45 cu. yds.
Lumber—70 pieces, 2"x4"x16'.
Lumber—5 pieces, 2"x10"x12'.
Lumber—4 pieces, 1"x7"x16'.

Labor 12 days for crew of 5 men or 60 days all told, including foundation and taking down forms when concrete is finished.

For silos of other diameters, the table below gives in detail the materials required.

Where a roof of concrete is wanted, it will take at least two days' more time. Excavation should be done by team and scraper, whereever practicable, as it is a faster and cheaper means of moving earth than by shovel.

Materials and Labor for Silo 45' 6" High

Dia.	Cement	Stone	Sand	Steel Pcs.	½" Length	Sq. Bar lbs.	Lumber 2"x4"x16'	Lumber 1"x7"x16'	Lumber 1"x2"x12'	Lumber 2"x10"x12'	Labor Men	Labor Days
10'	48 bbls.	30 cu. yds.	16 cu. yds.	81	17'	1170	50 pcs.	2 pcs.	20 pcs.	5 pcs.	4	12
12'	60 bbls.	40 cu. yds.	21 cu. yds.	84	21'	1420	65 pcs.	3 pcs.	30 pcs.	7 pcs.	5	12
14'	66 bbls.	45 cu. yds.	22 cu. yds.	87	25'	1880	65 pcs.	4 pcs.	30 pcs.	7 pcs.	5	12
16'	75 bbls.	50 cu. yds.	26 cu. yds.	82	28'	1950	65 pcs.	4 pcs.	30 pcs.	9 pcs.	5	12
18'	83 bbls.	55 cu. yds.	29 cu. yds.	84	31'	2140	78 pcs.	5 pcs.	40 pcs.	9 pcs.	5	12
20'	90 bbls.	60 cu. yds.	32 cu. yds.	86	34'	2430	78 pcs.	5 pcs.	40 pcs.	9 pcs.	6	12
22'	100 bbls.	65 cu. yds.	35 cu. yds.	82	37'	2680	90 pcs.	7 pcs.	50 pcs.	10 pcs.	7	12
24'	108 bbls.	70 cu. yds.	38 cu. yds.	84	40'	2860	90 pcs.	7 pcs.	50 pcs.	10 pcs.	7	12

John T. Simpson, one of the organizers of, and for a number of years president of the American Concrete-Steel Co., Newark, N. J., has disposed of his entire interest in that company and opened an office at 1224 Essex Bldg., Newark, N. J. to follow the practice of architecture and engineering. Mr. Simpson became early identified with the reinforced concrete industry, and was one of the first to suggest the use of reinforced concrete for school buildings. He was instrumental in having a number of such buildings erected throughout the country, having been able to reduce the cost of such buildings in many cases below the cost of non-fireproof brick and wood buildings.

Cement Eaters of Belgium—A Fantasy

The story of the charitable woman who was rebuked by the hobo for making mince pies of concrete has gone the rounds of the press and now has its sequel in Belgium, where they are making the finest quality of mushrooms out of Portland cement. Fortunately, in this instance, we are able to show the mushrooms. Our Belgium correspondent states that there is a certain wild tribe in that country whose habits are similar to the clay-eaters of this land, the distinction being that the Belgian people prefer Portland cement to clay. They are a strange little people, who come in the night time to pilfer from the concrete mushroom gardens. Now and then an individual will consume such immense quantities of concrete that it affects the entire system, causing the eater to harden into stone. On one occasion two of these little gnomes attacked a garden of mushrooms made of especially quick-setting cement (the kind the Belgian manufacturer sometimes sends out as an English product), with the result that they became petrified while hiding under a bench to escape the gardener, who had chanced to arrive before dawn. We show them as found in this position. The above facts concerning Portland cement are among the most interesting we have ever encountered.

Fig. 1—Concrete Mushrooms "Raised" in Belgian Gardens

Fig. 2—Concrete Gnomes Supporting Garden Seat

Industrial Cars Solve a Difficult Problem

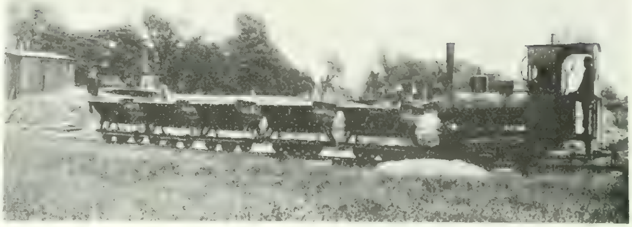

Fig. 1—Handling Concrete Materials with Industrial Cars

Costello & Co., contractors, Philadelphia, took the contract in the summer of 1912 for installing a sewage disposal plant at Bristol, Pa. The location of the work was such that all the crushed stone, sand and cement required had to be hauled from a railroad siding, a distance of one mile over fields, as there was no direct road between the two points.

It was necessary for them to handle five or six carloads of material per day and on looking into the matter they found that it would be impossible for them to obtain sufficient teams at a reasonable cost to handle this amount, due to the fact it was in the farming season and team owners were fully employed.

The question was referred to the Koppel Co.,[1] who advised the installatiton of a portable track railway, 24-in. gauge with Koppel standard double side-dump V-shaped cars of 1½ cu. yds. capacity, and a Koppel light steam locomotive. The contractors did this and carried on the work in the following manner:

A hopper was erected alongside the railroad switch and a derrick with a clam-shell bucket was located so as to unload the railroad cars into the hopper. Under the hopper ran the narrow-gauge track, and the cars were filled from a chute, the hopper being arranged so that the cars could take a full load only.

The portable track was laid roughly across the fields without any grading being done, numerous grades and curves being encountered.

At the unloading point, on account of unfavorable conditions, no dumping platform could be built so the cars were dumped on the flat, the track being shifted over as required.

A train consisted of five cars, and the locomotive, after taking out a train of loaded cars, would go back and spot a train of empties under the hopper. The empties were loaded while the locomotive was making the trip.

A round trip required about 12 min., so that the locomotive was able to make from 46 to 50 trips per day and haul, figuring 7½ cu. yds. per train, from 350 to 375 cu. yds. per day of 10 hours.

The advantages of the method used in doing this work can be clearly seen by comparing the costs with what they would have been if teams and 1½ cu. yd. dump wagons had been used, which was the only alternative.

A team could have traveled 24 miles per day, or have made 12 round trips.

With a 1½ cu. yd. wagon, the amount hauled per day, per team, would have been 18 cu. yds., and to have handled 360 cu. yds. would have required 20 teams. Figuring $4.50 per day as the cost of a team, the cost per cu. yd. would have been 25 cts.

The cost of the work, using the portable railway, including the wages of men whose employment was necessary on account of the use of the railway, but not including the hoisting engineer, hopper or hopper man, etc., who would have been required even if teams and wagons were used, was as follows:

3 men as track tenders and repairmen, at $2.00		$6.00
Operation of locomotive:		
1 Engineer	$3.00	
1 Switchman	1.75	
Coal	1.50	
Oil and Water	.50	
Total		6.75

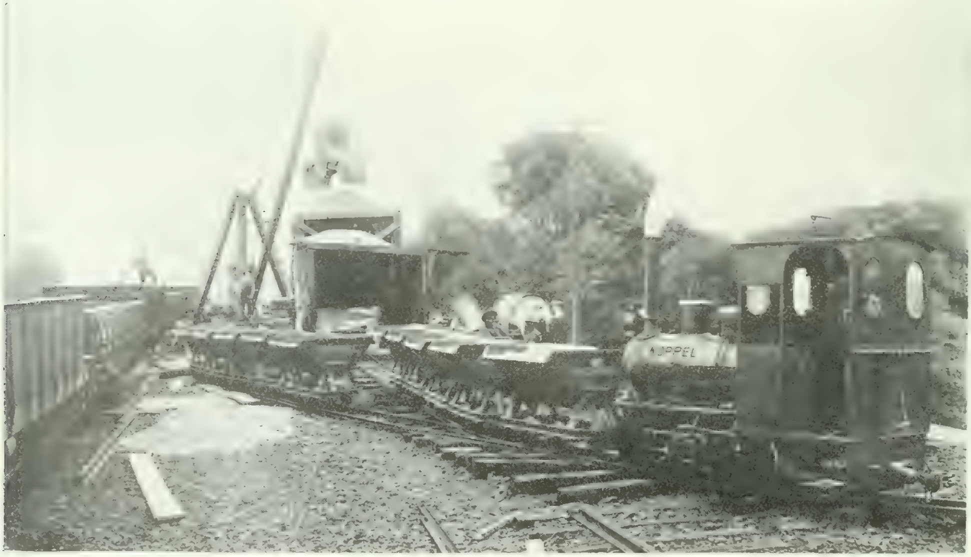

Fig. 2—The Cars After Being Dumped at the Site of the Work

The locomotive is just backing out with a loaded train. It will return and spot the string of empties before making the trip. The stiff-leg derrick is seen in the background, between the hopper and the loaded freight cars

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[1] Orenstein-Arthur Koppel Co., Pittsburgh

(Continued from page 102)

Interest and Depreciation on installment:	
6% Interest, on $4,875 ...	$292..50
20% Depreciation on $4,875 ...	975.00
Total	$1,267.50
Cost per day, figuring 200 working days ...	6.35
Total cost per day ...	$19.10

Total cost per yard ($19.10÷360) equals 5⅓ cts., or a saving of 19⅔ cts. per cu. yd.

To this must be added the cost of laying the track which amounts to approximately 1½ cts. per lin. ft., and taking it up and stacking it for reshipment, which equals ¾ cts. per lin. ft.

No trouble was experienced by the contractors from derailments as they stated that once only did they have the locomotive and train off the track, and this was clearly due to carelessness. The locomotive and cars have a very low center of gravity which helps to obviate this difficulty.

This type of equipment has proved to be of equal value in road building railroad grading, excavations, handling concrete, etc., and it can be accepted as an axiom that by the use of track and cars the cost of handling material is ¼—1/5 that of handling it by wagons.

Cantilever Wall Forms with Small Units

The idea of using in wall centering an extended stud which holds a section of form in place by being rigidly attached to the wall already finished, has been developed principally on heavy engineering construction such as dams, bridge piers, etc. In some recent building work, C. H. F. Dyhrkopp, Spencer, Ia., developed and has patented the centering shown in the drawings.

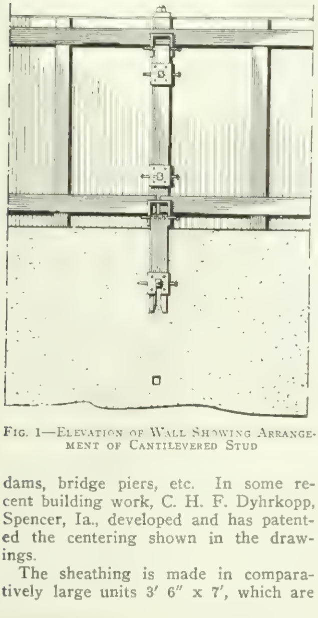

Fig. 1—Elevation of Wall Showing Arrangement of Cantilevered Stud

The sheathing is made in comparatively large units 3′ 6″ x 7′, which are built of wood faced with galvanized sheet steel. The studs used were of timber, but a light steel channel would probably work out better.

The operation is indicated in the sketch. With the wall part way up, or in other words, leaving out the detail operation in running the first course of the wall, the stud, which is slotted at the lower end is raised up and is slipped over a bolt or tie, which is left in the wall. A tie is used across the top, and other ties midway, if considered necessary. The essential feature of this development is the stud with the slot at the bottom.

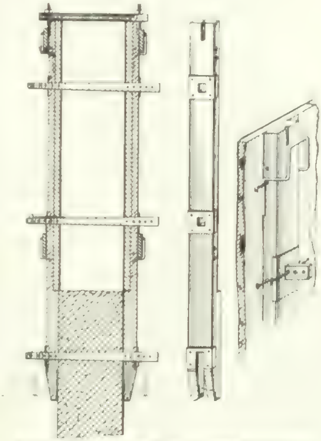

Fig. 2—Section of Wall Under Construction

The horizontal ledger board is held in place by a heavy wire looped over pins in the sides of the stud.

Usual practice in wall construction is followed. On the work executed, a tapered, approximately rectangular bar was used as a tie. This is also used as a scaffolding support when required.

The Engineer in Concrete Construction

It often seems, inasmuch as concrete construction is an engineering operation and requires trained engineers to handle it successfully, that an engineer for the building or a general engineer is to some extent, unnecessary. L. C. Wason, President of the Aberthaw Construction Co., Boston, takes a stand on this question which is interesting. This is stated in a recent letter to Concrete-Cement Age as follows:

We wish to state emphatically our belief that it is economy for any owner to employ a first-class engineer, however good the building outfit may be, and however well the owner may understand the requirements of his processes. A really first-class engineer will add ideas gathered from his general experience; will understand not only the requirements of the processes, but will add the details which go to make up the complete economical plant.

The process man looks at the building as part of the housing of his machinery. The building outfit looks mainly to the building as a piece of structural work. The competent engineer grasps the whole problem, and does not emphasize one thing or slight another. The habit of going to contracting firms specializing in some material and getting them to design the structural end of the job is likely to produce a one-sided design, and the owner should have some one who is competent to judge the details, and who is not directly financially interested in a material or any particular method of handling. One might at times feel alarmed at the size of the drug bills if one's doctor owned the drug store. An owner usually needs competent, disinterested advice as to saving money on details, as well as spending it in details.

We have seen in a number of cases that the services of the professional engineer have saved the owner at least 5% of the cost of what the building would have been without the engineer's services, to say nothing of the better design. The owner is thus virtually getting his engineering services for nothing. Long years of experience have proved that the customary method of employing a professional engineer is the best in the long run, and the exceptions, where an owner has not done this have simply proved more conclusively the value of the general rule.

Our most satisfactory work has uniformly been done in conjunction with a competent engineer.

Unit Cost Data on Bridge Materials

In a paper before the last convention of N. A. C. U., James W. Phillips[1] describes the work of eliminating grade crossings in Philadelphia. This work involved the construction of two concrete arch bridges and 20 steel bridges with concrete floors. The work required 151,800 cu. yds. of concrete masonry, and 231,800 bbls. of cement were used.

The following table gives the average unit prices of some of the important materials used in the work, except waterproofing:

1st class masonry, concrete backing, $9.50 per cu. yd.
1st class masonry, 3rd class backing, $8.14 per cu. yd.
2nd class masonry, 3rd class backing, $7.42 per cu. yd.
3rd class masonry, above neat lines, $5.71 per cu. yd.
3rd class masonry, in foundations, $5.43 per cu. yd.
1st class arch masonry, $11.25 per cu. yd.
1:2:4 concrete arch masonry, $7.95 per yd.
1:3:6 concrete copings, $7.54 per cu. yd.
1:3:6 concrete masonry (1½-in stone), $6.45 per cu. yd.
1:3:6 concrete bridge (¾-in. stone), $6.45 per cu. yd.

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[1] Asst. Engr. Dept. of Public Works, Philadelphia

1 :2 :4 concrete bridge seats (¾ in stone), $7.62 per cu. yd.
1 :2 :4 concrete pedestal blocks (¾-in. stone), $7.62 per cu. yd.
1 :3 :6 concrete masonry, above neat lines, street face, $6.74 per cu. yd.
1 :3 :6 concrete masonry, above neat lines, $6.32 per cu. yd.
1 :3 :6 concrete masonry, in foundations, $5.82 per cu. yd.
Dry stone back of walls and abutments, $2.65 per cu. yd.

Waterproofing

In waterproofing the steel bridges and viaduct, two methods were used; that of filling the trough floors with concrete and flushing it up against the webs of the girders, in case of half-through or through bridges, and then waterproofing the whole surface with a 1-in. layer of asphalt, laid in two layers of ¾″ each, with lapped joints. This method was used on all bridges between Green St. and Berks St., the bridges in the Tioga section and the viaduct. On the bridges between Berks St. and Broad St., the trough floor bridges were waterproofed with 1½″ of asphalt laid in two layers of ¾″ each, by covering the bottom, sides and tops of the troughs, and giving a transverse grade in the bottom of the troughs to their centers. Drainage was provided by inserting nipples in the bottoms of the troughs, which carried the seepage to a trough suspended below, these being connected to a down spout attached to the curb columns. The cost was as follows:

Felt (5 layers) with waterproofing compound,[2] $0.165 per sq. ft.
Hard brick laid in waterproofing compound, $0.08 per sq. ft.
Asphalt mastic, $34.67 per cu. yd.
Asphalt mastic on viaduct, $0.24 per sq. ft.

The arch at Berks St. was waterproofed by using five layers of "Genasco"[3] felt, laid in Genasco compound and protected by a layer of 1:3 mortar 1″ thick.

The Norris St. arch was waterproofed by using 1½″ of asphalt mastic,[4] and mixing it 1 part of compound to 4 parts of sand and screenings. This mixture was laid in two layers of ¾″ each, and each layer breaking joints.

The waterproofing on both of these arches has been very satisfactory.

The cost was as follows:

Berks St.	$0.23 per sq. ft.
Norris St.	$0.30 per sq. ft

In discussing grade crossing work in Philadelphia, J. W. Phillips of the Department of Public Works states that in the construction of two of the arch bridges, the Berks St., and the Norris St., it was necessary to construct each arch in two sections in order to maintain railroad travel. After the completion of the first section, railway traffic was transferred to the new elevation, when the remaining portion of the arch was completed.

The joints between the two sections of the arch ring were made tongued and grooved and 1¼ in. rods about 8 ft. long were placed in the first arch ring, having a projection of 4′ in order to engage the second section, when constructed. This was the only reinforcement used.

A Difficult Waterproofing Job

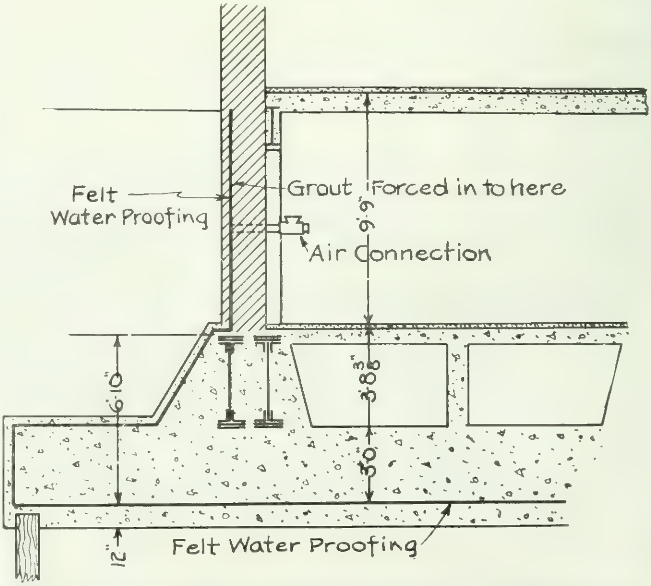
BY WILLET H. KELLOGG, JR.*

The Royster building at Norfolk, Va., is built on a pile foundation and is located on filled ground, where boats of various kinds used to have a landing, and within a short distance of the water front. The entire basement is subject to tidewater and great care was taken in placing the waterproofing in order to make the basement dry against a 12-ft. head of water. A high-grade felt was put down in six plies underneath a reinforced concrete floor 3′ thick, and was carried up back of 20-in. brick walls to grade.

The work was done with great care under careful inspection and on completion everyone believed the job to be a perfect one. After pumping was discontinued, however, sumps closed up, and water allowed to return and come in contact with the felt, it was discovered that in the erection of the structural steel columns against the walls, back of which the felt was carried, the felt had been punctured and damaged. The work also had not been properly grouted back of columns, thereby increasing the leakage.

To tear down the brick walls and tear up 3′ of concrete floors in order to locate leaks in this felt and repair it would have been so expensive as to be clearly out of the question. It was necessary that the basement be dry. On the job was an air compressor run by an electric motor. At 35 different points in the 20-in. brick wall where definite leaks showed, a 3-in. iron pipe was inserted into the wall. This was fitted on the exposed end projecting out into the basement with a 3-in. T connected to the compressed air tank. The air was kept at a pressure of approximately 100 lbs. Cement grout, which had been tempered with Waterbar[1] waterproofing compound was fed into the opening of the T as fast as the compressed air would carry it through the 3-in. pipe and out against the felt. The compressed air seemed to distribute this grout, forcing it through all leads and openings it discovered and filling all crevices. By this means grout was forced into all the openings which must have been in the felt seal, closing them up and making the work watertight.

In some instances grout would appear 20′ away from the point where it was being injected into the walls, showing that it traveled any course available back of the wall until all crevices were filled. When no more grout could be forced into any particular opening made, it was assumed that all crevices had been reached which could be filled from that opening. One of the outlets of the T was then closed and the air compressor kept on the other until the grout set. The T was then removed, and this operation repeated at any other point where there was evidence of a leak until the entire basement was made dry.



Section of Wall and Mat Foundation Showing Location of Felt Waterproofing and the Grouting Pipes

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[2] Hydrex Felt and Engineering Co., N. Y. C.
[3] Barber Asphalt Paving Co., Philadelphia
[4] Compound No. 483, made by the Barber Asphalt Paving Co., Philadelphia

*New York City.

[1] Girvan-Nachod Co., New York City.

Concrete-Cement Age

Vol. II MARCH, 1913 No. 3

Editorials

DEVELOPMENTS in concrete construction are of vital interest to everyone who is facing any housing problem whether on an individual or a community basis. This issue contains practical suggestions along the line for architect, builder, owner—it is at once a progress report and a prophecy of better homes for less money—of *Concrete Homes For Everybody.*

* * *

THE BIGGEST field of work in concrete construction in the next few years must be in popularizing its utility and beauty in building homes. This is not to be a popularization in the cheapening sense but by a general adoption of the material because of its great variety of adaptation, because of the economy and comfort which it makes possible in producing homes which may be distinctive though but modest cottages.

* * *

THOSE WHO investigated concrete houses a year or so ago do not know the possibilities of concrete house construction *today.* Engineers, artists, artisans who are studying the many useful applications of the material are making phenomenal progress. The concrete house is the house of the present and the future. Now we can show many, many examples. These examples are to become the rule. As this issue of your magazine goes to press we have a letter from a progressive architect on the Pacific coast. Two years ago he did some work in the construction of concrete dwellings which attracted wide attention. Today he hesitates to make a record publicly of the methods of construction then used because the developments since that time made possible work so much better.

* * *

SOME OF THE early developments in concrete construction appealed to the general public as something in the nature of freaks, so far as dwelling house work was concerned. The general public mind does not take quickly to new ideas which tend to overthrow home ideals. Early curiosities in these lines were naturally to be expected the inevitable result of experiments with a new and interesting material by means of which many old architectural conceptions and structural forms might be disregarded. *Now,* concrete home architecture has settled down to more definite achievement; day by day its work is establishing standards and day by day are new methods, better methods, bringing down the cost. Architects are interpreting old home traditions in a new material—a material in which things so long-lived even as *tradition* may be comfortably housed for an indefinite time.

* * *

HENCEFORTH every issue so far as possible will be a "house-building number." Developments in concrete construction generally contain so much that is germane to the subject of house-building that *house ideas* must be an important feature of every issue—practical ideas, full of suggestions as we can make them for the architect, builder, owner.

The Well Equipped Products Plant Elsewhere in this issue will be found some correspondence bearing on the question of what ails the concrete block industry. Those of us who have the best interests of the industry at heart know that improvements are demanded, improvements that are quite possible to make. The point brought out in the discussion is one on which we have insisted, editorially, for a number of months. It is that concrete products in unit form must be made in a plant, with proper equipment, under constant, competent supervision, and under constant conditions possible with adequate equipment and supervision. Uniformity of product depends on constant conditons and any variation in conditions means variations in quality. It is a source of gratification to find that the workers in the concrete products field are alive to this important fact. The manufacture of concrete units has developed, from its original status of an enterprise of separate individuals, into an industry that engages the capital and the attention of intelligent men of business. The almost frantic campaign against concrete products, now being waged by the clay men, is their last effort to stem the tide. Their competitors in the concrete industry, formerly to be sneered at as unimportant, are standing on the same level with the clay plants, as manufacturers. Aggressive, successful competition is possible on a plant basis only.

* * *

More Letters Wanted on "The Concrete Block" And despite the good ideas which come to us in the symposium referred to above, the subject isn't half disposed of.

What have the architects to say? They have been the chief critics. Let us have plenty of *constructive* criticism.

What have the manufacturers of concrete blocks and cast stone to say? Are there no developments having an important bearing at this time?

* * *

A Word to Mr. Concrete House Builder If the magazine is as full of suggestions for you as we believe it is, you will have questions to ask. The Information and Consultation department exists to consider questions. Usually we know the man who knows the answer to your question. Every reader of CONCRETE-CEMENT AGE is welcome to the advantages of that department.

* * *

The Use of Slag as a Concrete Aggregate Section 174 of the revised building code of Los Angeles has been revised to include slag as a concrete aggregate. The revision is in the form of an amendment of section 174 and reads as follows:

This section remains intact, except for the insertion of the word "slag" in the first sentence of the first paragraph, which will hereafter be allowed as a substitute for broken stone, in the same manner and proportion as clean screened gravel has heretofore been allowed.

* * *

Brick and Clay Products Try Knocking Concrete The Ford Motor Co. is planning to build a new factory in Seattle. A few weeks ago a similar announcement was made covering a new Ford building to be erected in Los Angeles. The announcement stated that the Los Angeles building was to be of reinforced concrete. Our first advice in regard to the Seattle building came to us indirectly from one of our subscribers, a concrete brick maker, who is, as it happens, also on the mailing list of *Brick and Clay Record*, a Chicago contemporary. He recently received from the "Get-Together Department" of *Brick and Clay Record* a flaming circular with large type scare-heads, an interesting document, and strikingly indicative of the attitude of the brick and clay interests.

A printed letter on the fourth page of the circular is, to quote the first paragraph, "a direct appeal to every clay product manufacturer in the United States who wants to see brick hold its own."

This letter further sets forth that while the original plans for this Seattle building called for brick, "the concrete people—always alive and thoroughly organized—have persuaded John Graham, the Seattle architect for the Ford Co., to advise the use of concrete." The letter further states that the Washington Clay Workers' Association of Seattle telegraphed *Brick and Clay Record* for aid; and that *Brick and Clay Record* "telegraphed every association of a national character and urged them to use their influence in an effort to convince the Ford Co. that concrete should not be substituted for brick."

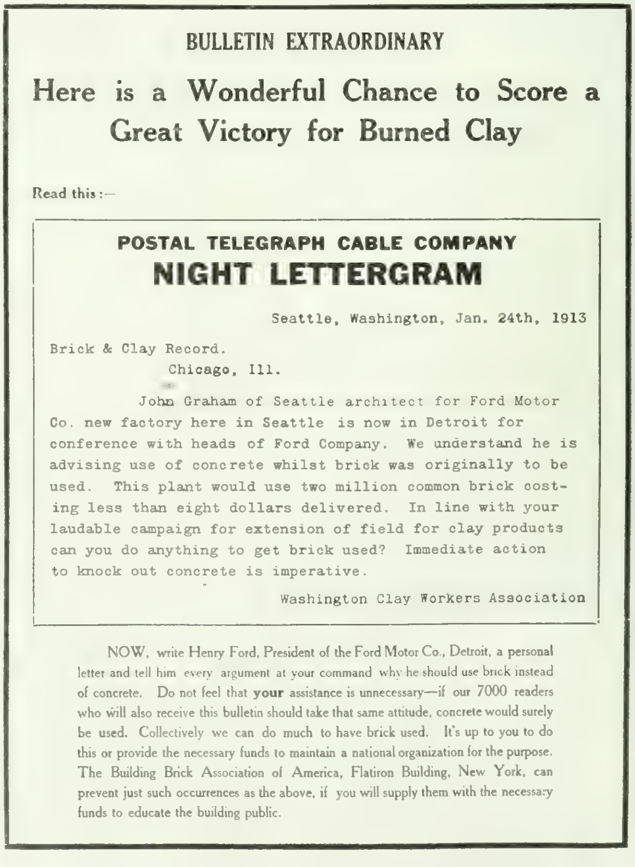
We quote from the circular further:

"You know that brick is a better material for factory construction than concrete—you know it is more durable, more fire-proof—that it is far cheaper in the long run.

"What we want you to do is to write the Ford Co. and tell them this.

"If you are an owner of a Ford automobile or expect to buy one, say so in your letter.

"If you have any clippings from newspapers showing concrete failures in



BULLETIN EXTRAORDINARY

Here is a Wonderful Chance to Score a Great Victory for Burned Clay

Read this:—

POSTAL TELEGRAPH CABLE COMPANY

NIGHT LETTERGRAM

Seattle, Washington, Jan. 24th, 1913

Brick & Clay Record.
Chicago, Ill.

John Graham of Seattle architect for Ford Motor Co. new factory here in Seattle is now in Detroit for conference with heads of Ford Company. We understand he is advising use of concrete whilst brick was originally to be used. This plant would use two million common brick costing less than eight dollars delivered. In line with your laudable campaign for extension of field for clay products can you do anything to get brick used? Immediate action to knock out concrete is imperative.

Washington Clay Workers Association

NOW, write Henry Ford, President of the Ford Motor Co., Detroit, a personal letter and tell him every argument at your command why he should use brick instead of concrete. Do not feel that **your** assistance is unnecessary—if our 7000 readers who will also receive this bulletin should take that same attitude, concrete would surely be used. Collectively we can do much to have brick used. It's up to you to do this or provide the necessary funds to maintain a national organization for the purpose. The Building Brick Association of America, Flatiron Building, New York, can prevent just such occurrences as the above, if you will supply them with the necessary funds to educate the building public.

factory construction, enclose them in your letter.

"And, above all, do not delay, but sit down to-day—NOW, and write the Ford Motor Co., at Detroit, Michigan.

"This appeal is sent to every subscriber of *Brick and Clay Record* and if each one of the 7,000 readers of this journal will write a letter, even of only a few lines, think what a great effect it will have on Mr. Ford."

We are reproducing herewith the third page of this folder. The last sentence is interesting, and in a way indicative of the entire effort; to knock out concrete seems to be the one idea.

We have tried to sum up and present this matter about as it came to the desk. Getting away from the question and acquiring a perspective on the situation as a whole, such efforts to "knock out" a competitive material would seem amusing if they were not so pitiable. Such feverish energy is worthy of a better cause. Under the circumstances the letter evidences an utter lack of comprehension of the realities, comparable to that of a small boy trying to stop the progress of a motor truck with a wedge of cocoanut cake. All it means is wasted cake.

The first comment on running through this circular was "futile piffle!" Henry Ford has used concrete, and will, we are confident, use it again. The acres of buildings on the outskirts of Detroit which house the Ford manufacturing activities are of concrete construction, with a brick veneer. The Ford Service building[1] in Detroit is of concrete construction with white glazed tile finish.

We wish most earnestly that our friends, the brick people, would get down under the surface, would dig into the facts and details of modern construction. In building an automobile factory, or a factory of any kind, brick and reinforced concrete are not competing materials. For the structure of the Seattle building, the columns, girders, beams, slabs and lintels, reinforced concrete will be used. Whether brick, glazed tile, or concrete is called for in the surface treatment is a detail of the work which may best be left to the judgment of the architect designing the building. He undoubtedly has certain ideas to bring out in the artistic development of the design. A well-made brick, coming down to us from the past, with its many Biblical and historical references, is a useful building unit, but it is not a structural material in itself. After "knocking out concrete," what would our friends use in the actual construction of this Ford factory? Imagine a building exclusively of brick, massive wall construction with little lighting area, all the interior floors supported on massive columns and carried by groined arches; all right for a monastery in the Middle Ages,

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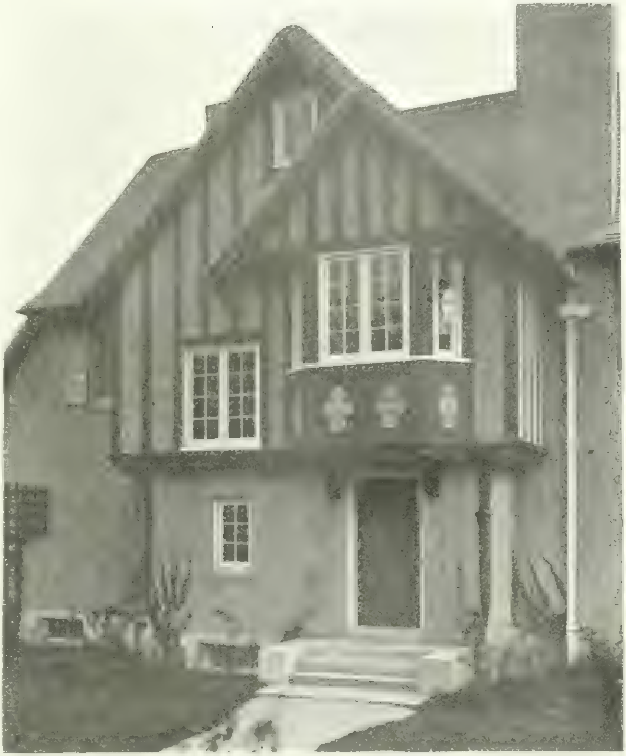
[1] Construction features of this building were described in detail in *Concrete Engineering* Nov., 1910

A Concrete House May Have Walls of Beautiful Texture



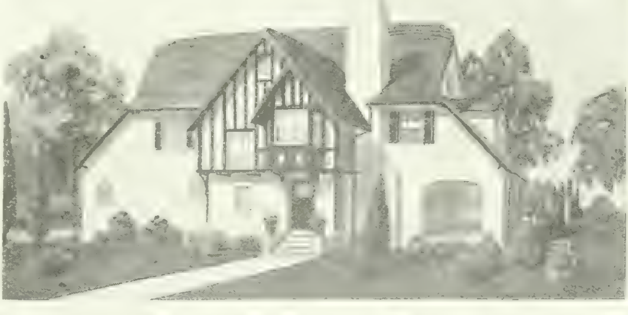
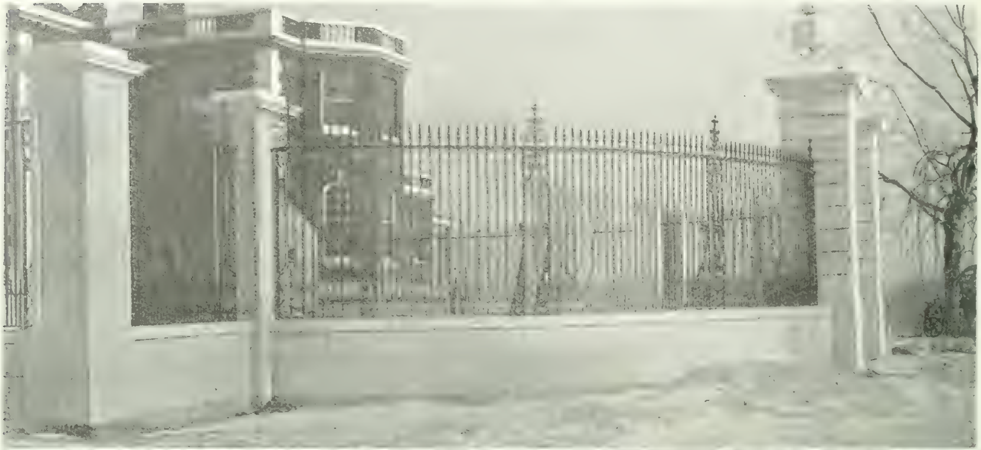


Fig. 1—Illustration From Photograph Showing Detail of House at Jamaica Estates, Long Island, N. Y.; Oswald C. Hering and Douglass Fitch, Architects, N. Y. C.
Fig. 2—Illustration From Water Color Sketch of Jamaica Estates House, of Which Detail Is Shown Above

This house is built of "Tilecrete"—concrete tile with stucco finish given "dry-dash" of chips of white marble, blue stone and yellow pebbles, producing a wall very beautiful in color and texture. This house and another were built under one contract but the one illustrated could be built in the vicinity of New York City for about $8,000

Showing Possibilities of Factory-Made Concrete



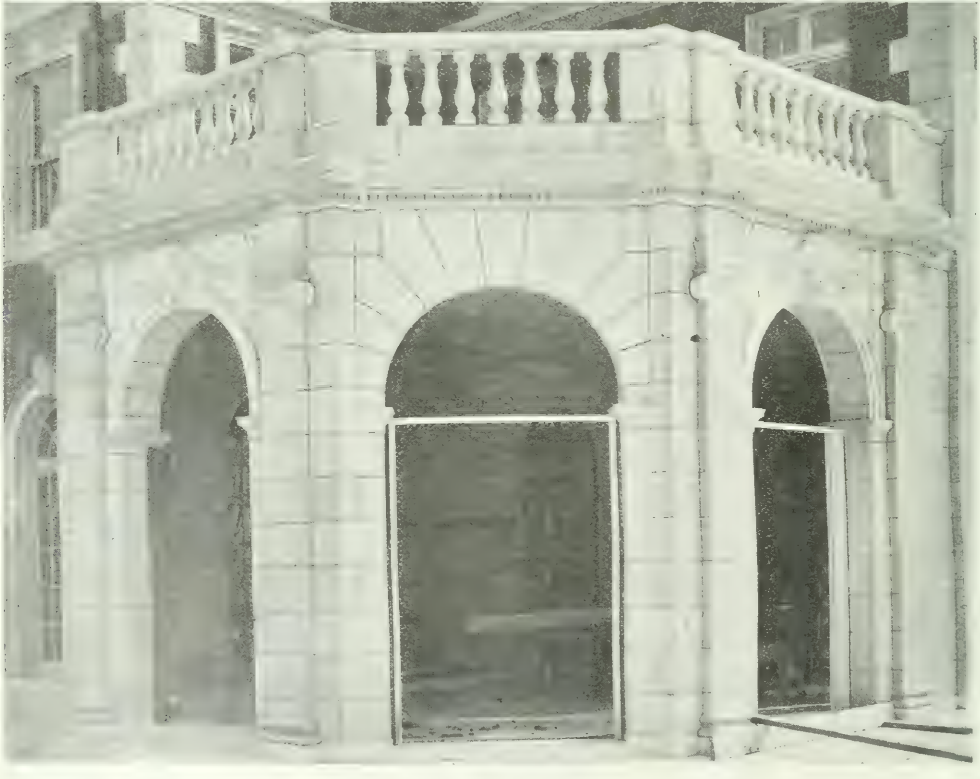


Fig. 1—Fence of Cut Cast Stone and Iron

Fig. 2—Exterior Detail R[illegible] Ormond C. Smith, Oyster Bay, Long Island, N. Y., Now Under Construction, Noppin and Koen, Architects, N. Y. C.

Both these illustrations show cast concrete stone, with all exposed surfaces cut and tooled, manufactured by the Onondaga Litholite Co., Syracuse, N. Y. The delicate detail in the concrete units forming the arches in Fig. 2 was all done by hand after the stone was manufactured. Gouverneur marble was used in the production of this concrete. The methods of the company making this product were described last month but in this day, and for a factory building, absurd.

There is no call to get excited over this recent incident, or even to trouble Mr. Ford or his architect with any pleas to save the day for concrete. They know what they are doing, are well informed on the relative merits of different building materials, and have used concrete in other buildings. We are willing to let concrete construction speak for itself, and stand strictly on its own merits. In a case where concrete as a building material has already demonstrated its value, nothing more need be done.

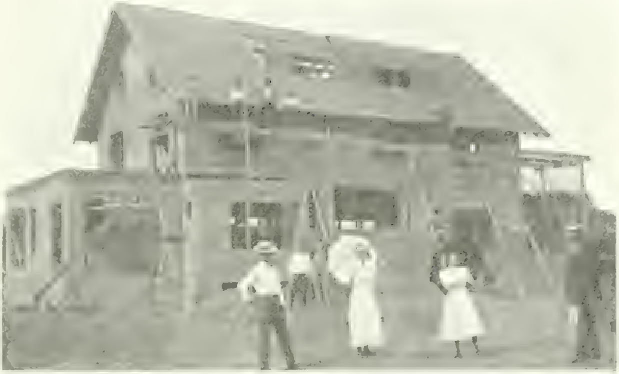
Automobile transportation and reinforced concrete construction are two of the most important factors in 20th century social service. It is fitting that they should serve one another, and be linked together at many points, not in factory construction alone; the great automobile development had made the demand for better roadways imperative and concrete has met this demand. The automobile and concrete in all uses make for better industrial conditions, better social living. A brick, ancient and venerated and still welcome as a valuable building unit, is only a brick. Concrete is the construction material universal.

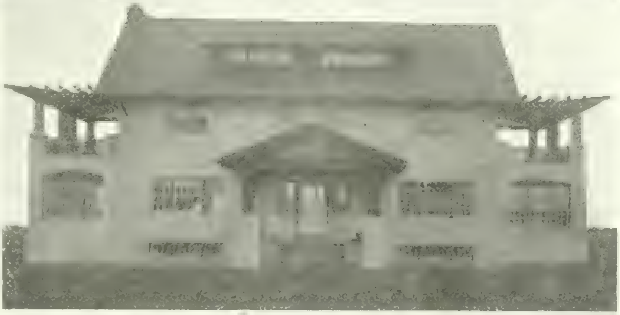
Let Gravity Do the Work This issue records the construction of a reinforced concrete residence in the Pittsburgh district. The house is of solid poured monolithic concrete floors, walls, beams and girders; ordinary building methods in handling wooden forms, the mixer plant, etc., were used. An interesting feature of this work is the way in which the contour of the ground on which the building is located assisted materially in handling the concrete. The building is on a hillside and about 100 ft. from the rear and 60 ft. higher than the house ran an alleyway. In the "backyard" out by the alleyway, the cement shed and mixer plant were placed. The concrete was brought down into the house in a long, home-made timber chute with a distributing spout at the end to place the concrete where it was needed. Gravity is the cheapest power available when it can be used, and contractors should, at every point possible, take advantage of it. In handling concrete that has to be elevated, study each problem individually and assemble the equipment to handle the work most economically.

* * *

Supporting Centering on Frozen Ground It is at this season of the year that the builder who has any work under contract usually tries to take time by the forelock and get up all the centering for the first floor in freezing weather, so

Broad and Generous in Design and Permanent





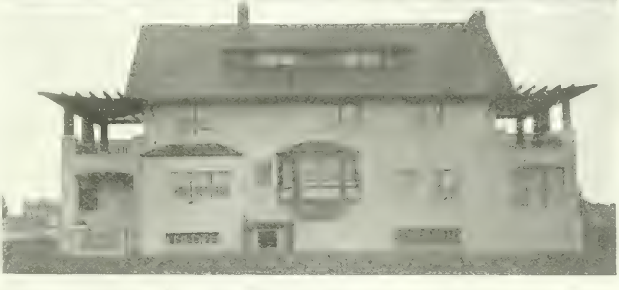
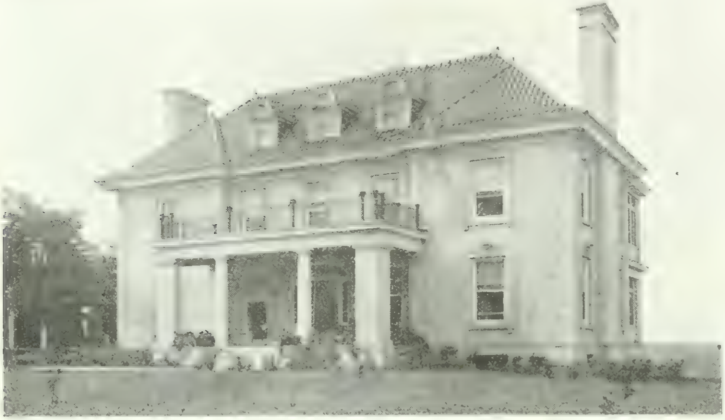


Fig. 1—Double Wall Concrete House Under Construction
Fig. 2—Front View of House Practically Complete
Fig. 3—Rear View of House

The accompanying illustration shows a double wall monolithic house, recently completed at Smith Town, Long Island; built along "Craftsman" lines and carries out every detail of the ideas of The Craftsman Architects, N. Y. C., who designed the house. Smith Town is in the Oyster Bay district and the owner of the house is F. J. Wagner. The roof is red tile and the walls refined by rich stucco finish. The house is 46′ x 26′ 6″ in plan. There are three large porches—one in front 14′ x 8′ 8″ and one at either end 24′ 6″ x 11′. One end porch is arranged for a sun room, and the other as a dining porch. The entire outside walls including porches and porch piers, were constructed with the Van Guilder hollow wall machines. The double walls, with a continuous air-space between them, were built in courses around the building, each course being 9⅓″ high. This method produces literally one house within another, the walls of which do not touch each other at any point, and are absolutely damp- and frost-proof. These two walls are tied together securely with galvanized iron ties, and are thoroughly steel reinforced horizontally. A rather unique method was used to build the columns or wall pilasters. These were built in sections in a separate machine adjacent to the work, and when hard were set in place. They are built hollow to prevent absolutely any penetration of dampness or interior condensation. A Precision continuous mixer was used throughout on the work. The contractor was Joseph Mulvey, 395 North Ave., New Rochelle, N. Y.

Three Distinct Types of Concrete Homes

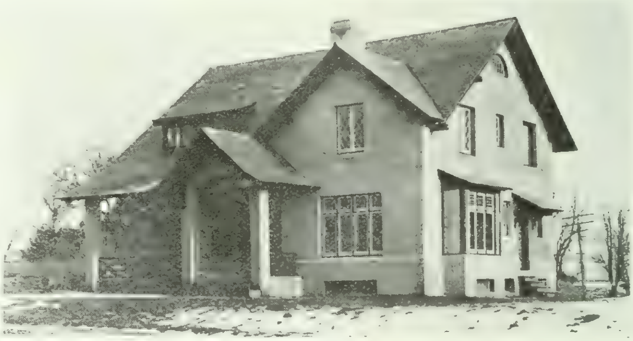


RESIDENCE OF E. H. DANN, SYRACUSE, N. Y.; A. L. BROCKWAY, ARCHITECT

The exterior walls of this house are built with a 4-in. veneer of cast concrete stone, all surfaces tooled, manufactured by the Onondaga Litholite Co., Syracuse; this veneer is backed with 8″ of hollow terra cotta tile. The concrete stone is made with graded Gouverneur white marble. The house cost approximately $18,000

THIS ALBANY, N. Y., RESIDENCE, SHOWN AT THE RIGHT, IS OF POURED CONCRETE, DOUBLE WALLS, BUSH HAMMERED SURFACE

The house is 39′ x 30′ in plan not including porch projections. It was designed by Charles R. Selkirk, architect, Albany, and built by C. R. Knapp, Albany. Each of the double concrete walls is 4″ thick with a 4-in. air space. The foundation is 14″ thick. The roof is of asbestos shingles



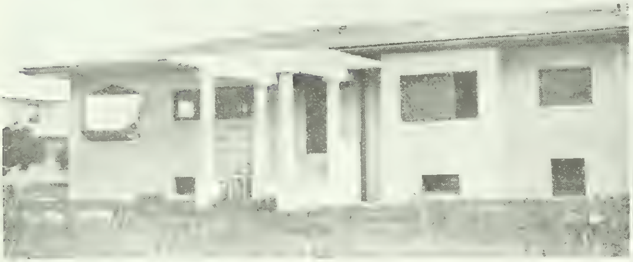


FIG. 1—SHOWS PART OF A CHICAGO BUNGALOW BUILT BY THE AIKEN SYSTEM

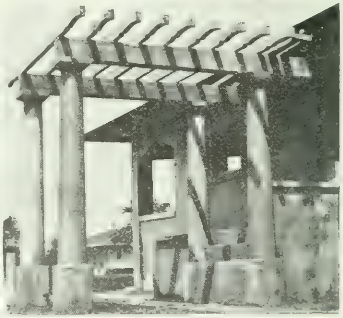


FIG. 2—DETAIL OF PERGOLA

This dwelling of unique lines is 29′ x 66′ in plan and cost $5,300. The walls of the house were cast flat, horizontally, and lifted to their upright position when thoroughly hardened. Four in. partition tiles were first put on the flat plank form and then concrete and reinforcing placed, allowances being made in the enormous slab for all window and door openings. Reinforcing bars projected at the ends of the slabs, these projections being used in making secure joints when the four walls were in place. The bungalow has eight rooms, besides bath; the living room is 28′ x 16′. It is the home of Gaylord Harvell and was erected by the Monolithic Concrete Construction Co., M. C. Weber of that company being the architect that he can run concrete at the first thaw. As we all know, frozen earth is a pretty hard material, and in setting shores the average mechanic has not as much foresight as he might have; a small sill or shoe under an upright usually seems sufficient to him on frozen ground.

A thaw, however, soon converts what was a hard resisting material into soft mud, and every precaution should be taken to provide proper bearing for the vertical shores so that there will be no settlement in the floor centering. It is good practice at this time of the year to use extra large sills, use long planks continuosly under every shore, and leave the wedges out far so that when the ground begins to soften the wedges can be taken up and the sill forced firmly into the soft earth. Precautions taken in this way will save trouble later on.

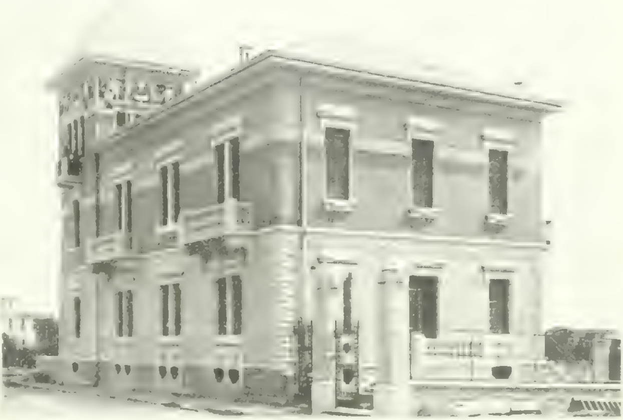
* * *

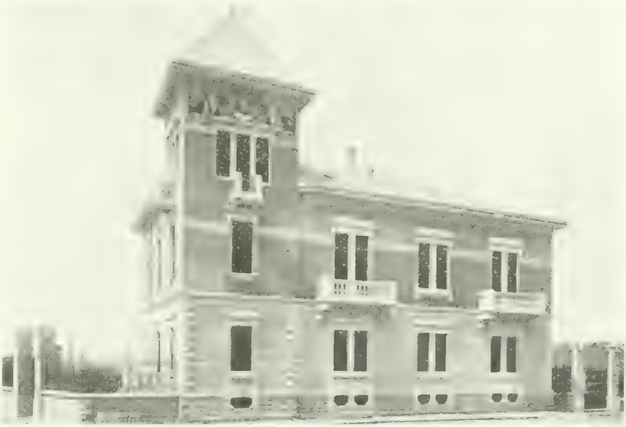
Reclamation Work in the Heart of a City An open stream through wooded hills and rolling meadows is a thing of beauty and a joy. The same open stream, through the heart of a city, is usually a sewer, an open polluted disease breeding waterway. We know of many examples of such open streams, rapidly becoming fewer, thank goodness.

Through the heart of Baltimore flows Jones' Fallsway, a broad, sluggish stream, lined with buildings, factories and warehouses. Baltimore has spent a million in bridging it at various cross-streets, several more hundreds of thousands of dollars in erecting and maintaining masonry retaining walls. Top these two items with the terrible cost in life and property of floods which have swept down this restrained waterway, and we begin to arrive at some idea of the cost to the community of such an open stream. It is, in fact, a civic drain in more than one sense.

An article in this issue describes the worderful part that concrete plays in the transformation of this condition. In place of a polluted alleyway river we find a broad paved city highway, furnishing needed communication between different parts of the city. The river is carried in a three-celled conduit, so arranged that under normal conditions all the water is carried in one section. This gives a sufficient head

Concrete Block Houses In Italy





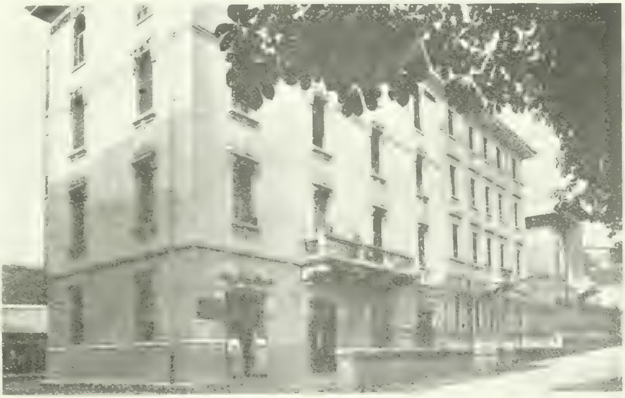


FIG. 1—(TOP) ITALIAN RESIDENCE BUILT OF CONCRETE BLOCK AT COST OF $28,000

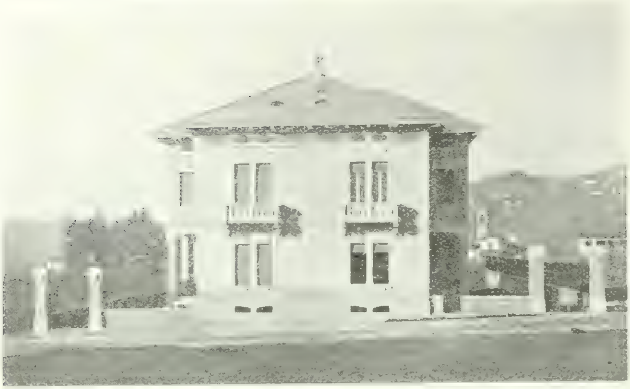
FIG. 2—(CENTER) ANOTHER VIEW OF RESIDENCE SHOWN IN FIG. 1

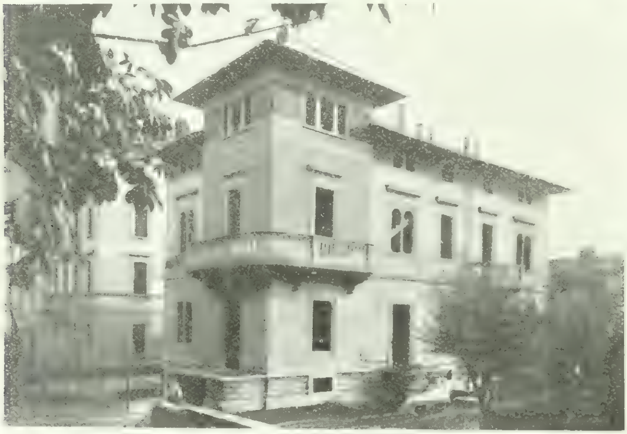
This elaborate residence was built near Lake Maggiore, Italy, for a banker, by Villa & Co., contractors, superintended by Rosa Cosmetta & Co., Milan. Ideal Concrete Machinery Co. equipment was used to make the 11,700 block used in foundation and walls. Some of these block are faced and "tycreted" and some of the wall areas are stuccoed. The trim stone is white-faced block

FIG. 3—(BELOW) TENEMENT HOUSE AT BERGAMO, ITALY, BUILT OF CONCRETE BLOCK

This four-story structure utilizes Monarch block in the basement walls and Ideal block above. Ten-in. block were used in the three upper story walls and 12-in. below—in all 15,000 block were used and the entire work cost $14,000. The building is 45' high; Villa & Co., contractors; Rosa Cosmetta & Co., superintendents

Three More Italian Examples





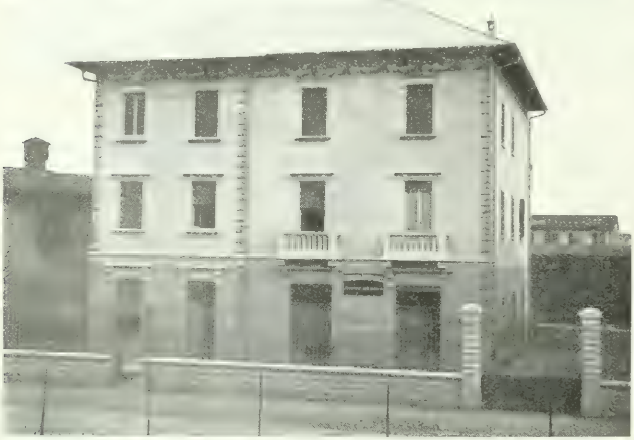


Fig. 4—A Italian Residence Somewhat Similar in Treatment to That Shown in Figs. 1 and 2 and Built by the Same Contractors

Fig. 5—This is Contractor Villa's (Villa & Co.) Own Residence at Milan, Italy
Built of Ideal block with concrete used throughout the interior including reinforced concrete stairways; some of the blocks were faced and left exposed and some are covered with stucco, of which Italy is so fond

Fig. 6—A Tenement House of 30 Rooms Built in Milan for $5,000

so that the scour keeps the box clean. At the entrance of this mile-long conduit a chamber is so arranged that when the water rises above a certain level the second or middle chamber takes the overflow. When the water reaches the maximum as in the case of flood and heavy rainfall it can be carried in still a third conduit.

The deck of the conduit is paved, forming a 75-ft. wide boulevard. This is an example of reclamation work in the best sense of the word, and Baltimore is to be congratulated on the work accomplished.

* * *

Steel Wall Form Units for Concrete Work In the minds of those who have been active in concrete development in the past few years, it has always seemed that steel forms were developed primarily for use in residence work and other small construcion. The application of these small steel form units to larger work has been a continual surprise, but within the last few years their efficiency has been undoubtedly proven. The first large work which came to our attention on which steel forms were used was a large malting plant at Milwaukee. The contractors here were an engineering corporation of international reputation, who used the regulation small steel form units in running long stretches of plain wall. A confirmation of this trend in steel form development comes in a recent letter from an official of one of the larger firms manufacturing steel forms, who states that although they have sold over 100,000 sq. ft. of wall-form units, practically all of which is now in use, a great proportion of this is being employed in factory, warehouses, power houses, and foundation construction, and comparatively little in house building.

In considering the relative value of wood and steel forms it is well to remember that when a contractor buys lumber for forms he is buying material; when he buys steel forms he is investing in equipment.

Pumice Concrete Slabs for House Construction In a recent issue of *Progress,* a journal published in Wellington, N. Z., we note an advertisement describing concrete houses constructed with reinforced concrete pumice slabs. An illustration shows a boiler house with walls 3" thick constructed entirely of these slabs. According to the description, no plaster was used on this building and the exterior was painted with cement and a waterproofing material to produce a waterproof surface. These slabs can be handled much as wood is handled; ordinary screws can be screwed into these blocks without a previously bored hole. The advertisement states very emphatically that this material is as cheap as wood. This would depend, of course, very much on the price of wood in the locality, but there is no reason why such slabs should not be as cheap as wood in the long run almost anywhere.

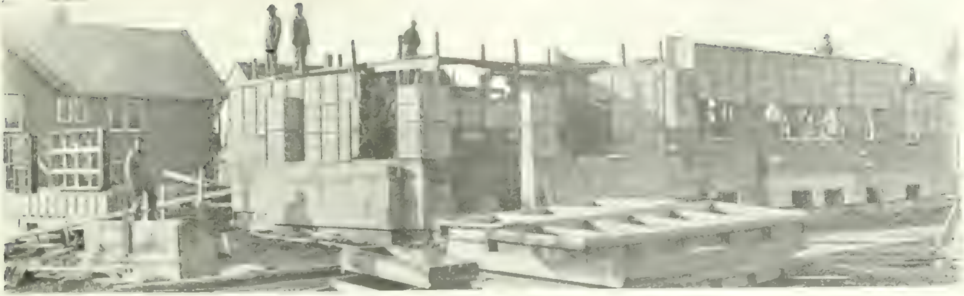
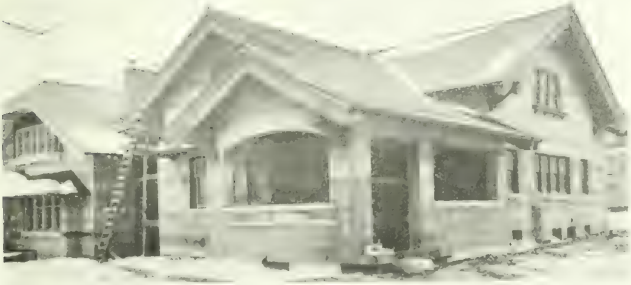


Fig. 1 [illegible]



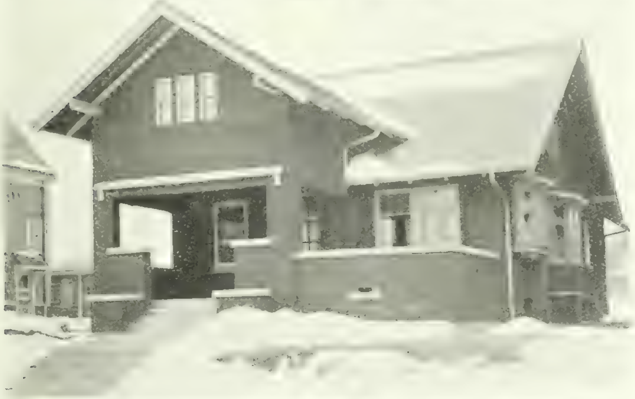


Fig. 2—The Same Bungalow as Shown in Fig. 1, Very Nearly Completed

Fig. 3—Completed House of Mr. [illegible], Milwaukee, Miller and Grossenbach, Architects. Built of Concrete with Reichert Metal Plates and Given Stucco Finish

Repairing Concrete Ceilings From Above Some of the earlier cinder fireproofing work is recalled to mind when our methods were rather crude and when for some reason or another big chunks of concrete used to pull down when the slab centering was struck. It was always hard to figure out how the big holes, an inch or so deep, and so big that a handkerchief could not cover them, could occur in the ceiling, but probably some laborer left a few nails sticking up in the slab boards or a rough dry board sucked the water out of the slab and developed a strong bond between the board and the concrete. At any rate the panel centering had to be pulled when the floor was quite green, and on the work that comes to mind there were several bad places in the ceiling that had to be patched.

This floor was a beater room in a paper mill and was about 18 ft. above the basement floor. The floor centering here was quite a difficult matter and when it came to making patches stick up against a flat ceiling it was quite a problem, but was solved by an ingenious foreman in the following manner:

He drilled a hole about [illegible] in. in diameter through the floor directly [illegible] panel. A [illegible] panel of light boards was then tacked together and held tightly against the ceiling by a light spliced and bowed upright. Working on the floor above, the hole was filled with water, through some kind of a funnel. This thoroughly soaked up the concrete surface and after the water had practically all run out a thin grout, about 1:3 mix, was then poured through the hole above. It was poured very thin and continually puddled. A few days later, when the panel underneath was removed, the patch seemed to blend in, and did not show at all after the surface was calcimined.

This method was particularly economical in this high story height as it was unnecessary to erect any scaffolding. The little panel was tacked on to the end of the upright and simply raised up into position. A sketch showing this arrangement is published on page 144 of this issue.

Use of Concrete in Buenos Aires Among our exchanges we note with interest "El Cemento," published in Buenos Aires. This is a most interesting indication of the fact that concrete is the construction material universal, for in the stress of our industrial development here, we often lose sight of the fact that cement is being used all the world over along very similar lines. In this South American journal we notice descriptions of systems of steel forms developed in the United States and also some advertising of materials manufactured in the States. The South American cities, almost without exception, have shown remarkable advance in the last few years and have modern improvements in almost every line of activity. How much of a field there is in South America for American machinery and American methods is still an unknown question, for the field is still undeveloped. With the opening of the Panama canal the means of intercourse will be practically doubled, for the canal will throw open the entire west coast of South America to our eastern industries and the west coast of South America to our Pacific industries.

Doorway Suggestions for Concrete Houses

Interesting Ideas of A German Architect On Design of Pleasing Residence Portals

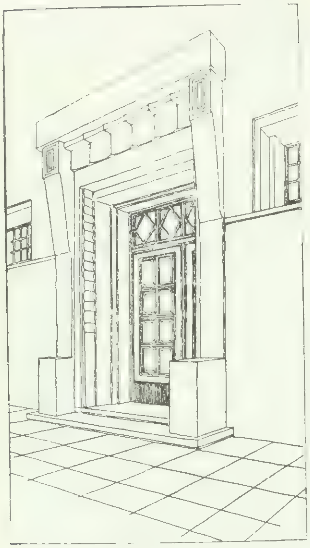


Fig. 1—A German Suggestion In Doorway Design

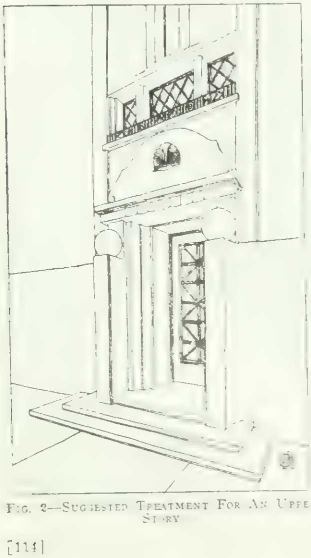


Fig. 2—Suggested Treatment For An Upper Story

To show just how well concrete lends itself to the design and construction of house portals, the German architect H. A. Jochem has prepared some sketches which are reproduced in *Der Betonbau.* The improvement in cement stucco work, which has been rendered possible by the recently introduced compositions, gives the architect opportunity to develop proper technical design and execution of such work. By reason of the differing properties of the various aggregates and other components which can be employed, the material has an extraordinary degree of adaptability; and it is an essential problem to find the limits by which the design of form and choice of decoration in the use of the material are bounded.

Assuming that any imitation of natural stone is not to be used it is essential that the stucco-like character of the mass should be preserved in the outline of the details. As the material can be given, by the various components, a fine grain and a very tender color tone, it is advantageous to form large quiet surfaces in which the structural beauty can show itself perfectly. Variety in the appearance of the surfaces can be attained by the choice of different color tones and different treatments of the surfaces. By this means the mechanical operations of roughing the surface of the still moist material can be carried out by various tools and instruments, or the surfaces may be worked with chisel or sand-blast after they have become fully hard.

The designs here illustrated show some architectural details which may be carried out in cement stucco. Their outlines are based on the above enumerated principles; and the examples have by their quiet appropriations a very good effect. All banal decorative details are avoided; and where there may be seen a modest decorative element, it is demanded by the construction, and in form suits the material in which it is executed. The forms of the architectural details are well suited to serve as models for cement stucco and artificial stone work.

A mile of concrete road, 12′ wide, between De Kalb, Ill., and Sycamore, Ill., has been formally opened for traffic. It is one of the first of the kind in the state, but will not be the last.

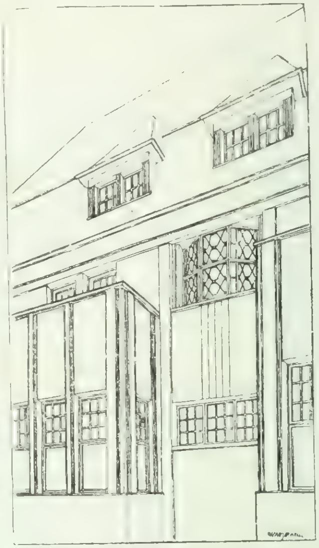


Fig. 3—Doorway Design Using Simple Decoration

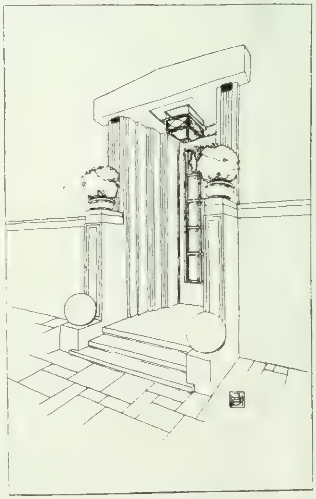
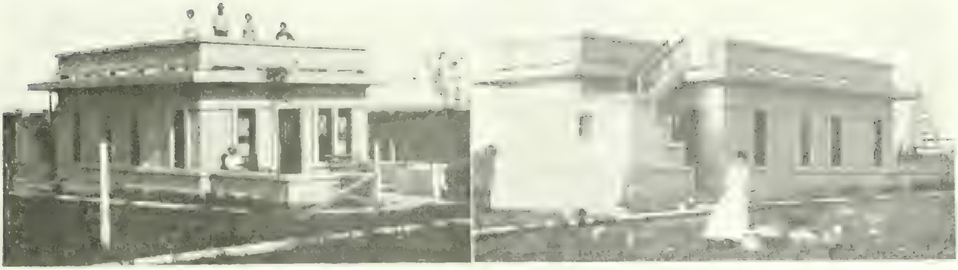


Fig. 4—A Recessed Doorway Using Vertical Lines and Some Decoration to Good Purpose



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Fireproof Houses on Western Plains

Simple Concrete Dwellings of Interesting New Type Built in Oklahoma for $2,000

The American people are to-day demanding better homes. In the American city of two decades ago, the average dwelling was of wooden frame and clapboard construction; the better structures, the brick and masonry residences, were "on the avenue." To-day, while concrete is being used for all classes of residences, the most radical changes have been in the residence for the average home builder, the small house builder, especially. A substitution of concrete for brick or cut stone in the construction of a stately mansion is more a change in architectural treatment, and the householder, while he senses a better, a more sincere treatment of materials, a more sympathetic interpretation of construction requirements, and while he realizes that with fire-resisting stairs, floors and roof, he is in a better, a more real home, yet he he has undergone an improvement in his surroundings only, and has experienced very little actual change.

The *average* housebuilder, however, of two decades ago, perforce had to be content with a timber firetrap, a wooden clapboard affair. Such construction has not been in the long run, economical, for depreciation and maintenance soon ate up the saving in first cost. Painting and repair bills make frame construction in the long run, expensive.

The accompanying photograph shows some small fireproof houses which have been built recently in Oklahoma. The two cottages shown are in a group of six, which were built last summer in a western state by the concrete home builder who in the July, 1912, issue, presented some most forceful reasons for building fireproof homes. This group of houses is located in the suburbs, and within 500′ of an interurban trolley.

The cottage shown in Fig. 1 is 20′ x 36′ in plan, exclusive of porch in the front, which is 10′ x 18′. It is finished with cement inside and outside, and has a concrete roof reinforced with expanded metal. The floors are cement finished throughout. There are five rooms, with a front and a rear porch, with a cistern on the rear porch. The selling price of the house as it stands was $2,000.

In Fig. 2 is shown a cottage with the same floor arrangement as the cottage shown in Fig. 1, the only change being that a sloping tile roof is substituted for the flat roof.

These cottages have fireplaces in the living rooms and are plumbed for gas in all the rooms, with gas for cook stove in kitchen. While outside toilet houses are provided with each house, yet a septic tank (3 chamber) is built and coupled up to a sewer that runs along the rear of each of the houses. There is also an 87-ft. bored well with wind mill and elevated pressure tank of 100-bbls. capacity. Pump and pipe connections carry water to each house so that any buyer may put in toilet arrangements at any time without going into the street for connections, and without paying any water tax or sewer tax. A concrete sidewalk[1] runs along the front of all the properties and is coupled up to the front porch of each property and to the interurban street car line.

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[1] These walks are described in the issue of July, 1912, as follows: The walks are 2′ wide and 2″ thick. No top finish is used at all, but a mixture of chats and cement only laid on top of the ground and rough troweled. This walk, 920′ long, cost $76.00, or about $12.30 per house. Such a walk will last 8 or 10 years and add materially to the usefulness of the cottages.

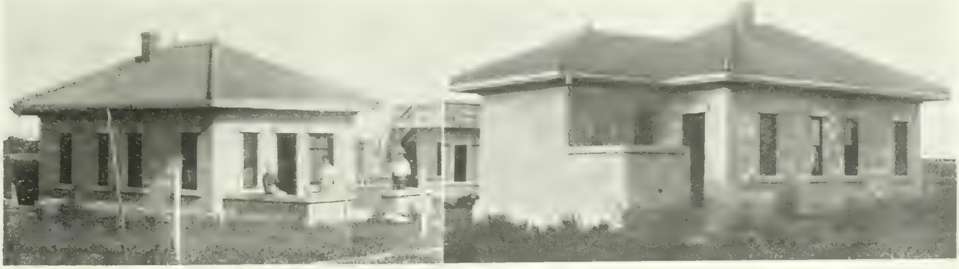

Fig. 2—A Cottage Similar to the One Shown in Fig. 1, but with a Sloping Tiled Roof

One fence surrounds the six lots which are each 75′ x 140′. Elm trees are set out along the front of the property and a concrete hitching post, poured, is in front of each plot. At rear of the house shown in Fig. 1 will be seen a little window under stairway that furnishes light for the toilet room which is built under the stairway. All of these things except the toilet room connections, go with each house at the price named.

For the time being, at least, this home builder prefers to remain unknown, but as an earnest, sincere, and forceful argument for fire-resisting house construction, a paragraph from the July issue referred to has a place in this description, for the cottage which resisted fire attack so well is of the same type as the ones shown in the attached illustrations. The paragraph follows:

> Some people who had bought one of these concrete cottages installed a gasoline cooking stove. The woman of the house was getting breakfast, her first meal on the new stove; three children were asleep, and the man was trying to catch a horse in a large pasture lot adjoining. The woman was in the garden cutting lettuce and went to her husband's assistance in the chase of the horse. When they were both a quarter of a mile from the house they heard an explosion and saw flames break out of their kitchen door and window. They came as fast as they could to the house, but did not get there in time to save anything in the kitchen. The kitchen cabinet, kitchen table, kitchen press, two chairs, the outside door and two windows were ruined; the fire was practically over; and the children were still asleep. The total cost of repairing the house was less than $30.00. The children would certainly have been burned up had it been a wooden house *Fire insurance would not have saved the children or replaced them. There is no "just as good" substitute for the fireproof dwelling.*[2].

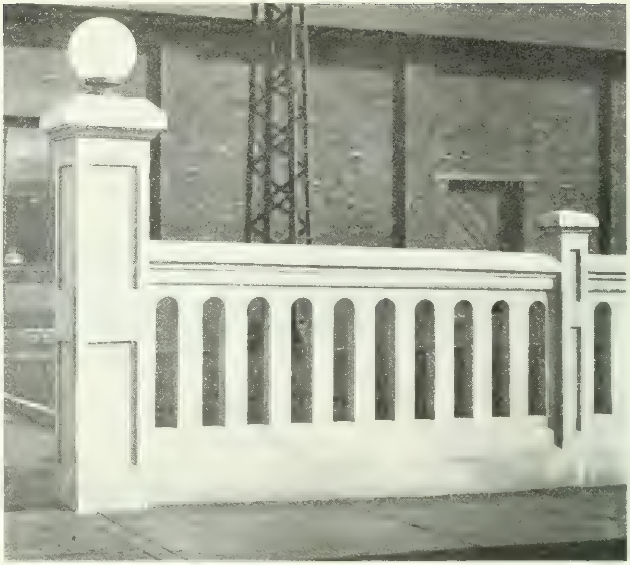

Fig. 1—Reinforced Concrete Fence

Reinforced Concrete Fence Built at Cost of 76 Cents Per Foot

The illustration and the detail drawing, Figs. 1 and 2 respectively, show a reinforced concrete fence built by the Carnegie Steel Co., New Castle, Pa., at a cost of approximately 76 cts. per ft. Post caps, panel caps and small posts were cast in collapsible box forms, open on one side. They were oiled and plastered inside with a 1:3 cement and sand mortar and filled with a mixture of 1:2:3 cement, sand and gravel for backing. The gate posts were built in position. They rest on a base 2′ square and 3′ deep under the ground. The reinforcing bars were set into this base and a collapsible wood mold set up over it. A 1:2:3 concrete was used, bring the mortar to the surface. A con- poured very wet and well spaded to duit was placed in the center of each gate post, as shown in the detail, to carry the electric wires and two 1⅛″ bolts were inserted on which to hinge the gate. In constructing the fence proper a trench was dug along the property line, the fence posts set in place and concreted into the sub-base which for the fence was 12″ wide and 2′ deep made of 1:3:6 concrete. The forms for the panel base were then set from post to post, bolted together and filled with 1:2:3 concrete. The panel forms were next set up, bolted together and filled with 1:3 mortar mixed wet and well tamped. The reinforcing rods in the pickets were put in place after the concrete had been poured. When the forms were removed all air holes and rough spots were troweled smooth and when the concrete had thoroughly hardened, it was washed with a mixture of lye, alum, cement and water, which whitened the surface. This surface later turned to a light gray and there has been no trouble from checking or crazing. The fence is 557′ long and there are seven of the large gate posts. The work was done by D. B. Woolcock, C. E., under the direction of John S. Oursler, General Supt. of the New Castle and the Sharon plants.

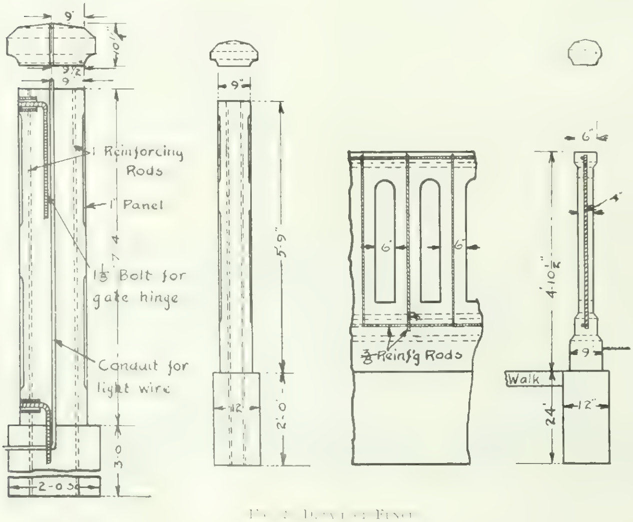

Fig. 2. Detail of Fence

Minneapolis will use 65,000 bbls. of Portland cement for 1913 paving. Evidently her experience with concrete pavements has been entirely satisfactory.

By unanimous vote, the trustees of Roch Township, Ia., have specified that concrete culverts only shall be used.

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[2]The italics are ours, and, we feel, thoroughly justified.—Editors.

Enclosing Jones' Falls, Baltimore, In Concrete

BY STUART STEVENS SCOTT

One of the most attractive and best paying improvements the city of Baltimore will ever undertake is the work of enclosing Jones' Falls in reinforced concrete conduits and building a roadway over them. What has for more than a century been a nuisance and expense and an eyesore in the heart of the city will not only be removed, but the city will have reclaimed a strip of land 75' wide and more than a mile long, which will become a broad, smooth roadway affording a much needed addition to north and south thoroughfares connecting the docks and business section of the city with the railroad depots in a northern section. This roadway will be an easy grade, enabling one horse to accomplish what now requires two, thus effecting a great saving in money and time to merchants.

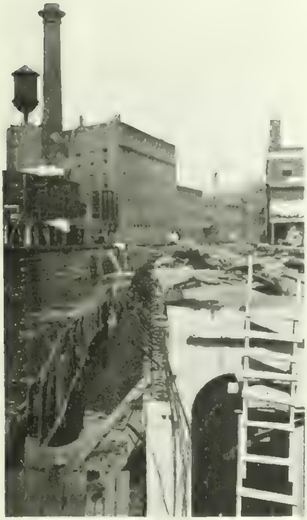

Fig. 1—The Conduit Under Construction

At the right is shown a section practically completed. The common wall is finished, a seat being left for the slab of the adjoining conduit

The improvement will transform back lots abutting an open stream into valuable land facing a broad boulevard. It will not only improve the property to the extent of securing for the city sufficient revenue from increased taxes to pay the interest on the bonds and create a sinking fund to redeem the loan, but it will eliminate the dozen expensive bridges and do away with the annual appropriation for bridge repair which ran into thousands of dollars.

Aside from the esthetic features, to say nothing of having an open sewer enclosed, more important will be the prevention of the flooding of property along the low-lying sections of the stream. Jones' Falls, although normally a somewhat sluggish stream, when accentuated by heavy rains, becomes turbulent, and has caused much damage by overflowing. The most notable instances were on July 24, 1868, and July 5, 1904. In 1868 the flood not only did damage to the extent of several hundred thousand dollars, but caused the loss of a number of lives. In 1904 the damage was confined to property, although many persons had narrow escapes.

Following this last flood and the construction of the new sewerage and storm water drainage systems, changes were made which have since kept the stream within its bounds, although there have been numerous periods of excessive rain-fall.

Notwithstanding the general belief that the Falls would never again leave its banks, the city authorities deemed it expedient to close the stream and thus make it absolutely safe.

From an economical point of view, the city could not have taken a better step. About 30 years ago, the city spent more than $1,000,000 upon retaining walls, and since that period has spent fully as much in addition in building and maintaining bridges. The enclosing of the Falls and the construction of the roadway will have cost approximately $1,300,000, and it has been estimated that the revenue from the increased taxation of property in the vicinity will pay back every cent of this expenditure.

All of the contracts for the work, which is being done in sections, have been let and the work of construction is now more than 25% advanced and, it is expected the whole will be completed within the next 12 months.

The total length of the sewer is 6,764'. It begins at the northern edge of the city, with a basin approach a little more than 100 ft. long, from which point the water flows into a tunnel 28' x 29' and 1,080' long to a junction chamber where begins a series of three ducts. The east duct is in section 8' x 14' 6" and the others each 17' x 17'. These ducts continue 1,400' to a point where the east duct is enlarged to 15' 6" x 16' and the others to 15' 6" x 20' each.

At a point 1,300' farther down stream the east duct is enlarged to 18' 6" x 15" and the others remain the same for the 2,800' to the outlet apron in the harbor.

The object in having the east duct smaller, is to permit its use for the ordinary discharge of the stream and to keep the water so closely confined that it will rush through with a force sufficient to prevent sediment and to keep the duct clean. As the water increases in volume in the junction chamber and overcrowds the east duct, it finds its way into the central duct. Should even this duct be overcrowded, there is the third one and it is believed that these three ducts will take care of even the heaviest rain-fall.

Although not so spectacular as many

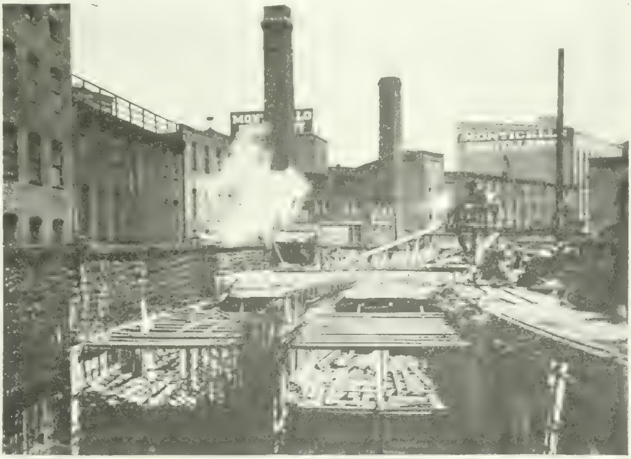

Fig. 2—Completing the Second and the Third Conduit

At the right is shown a finished conduit, much as shown in Fig. 1. The water is allowed to flow through the finished section, and the other two conduits built simultaneously. In the background, is shown the mixer which is rolled along the finished section and kept opposite the work being poured. The foundations and invert for two sections are in, and the steel for the central wall is in place. The old granite retaining walls are shown at the left

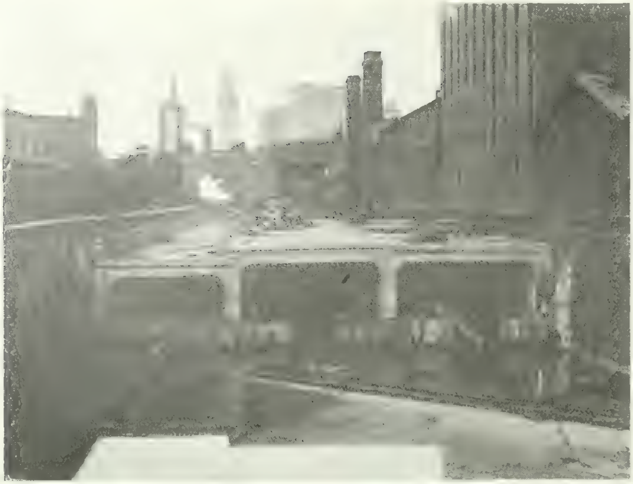

Fig. 3—The Three Sections of the Completed Conduit

This shows the recesses left in the slabs and columns into which the next section is keyed

other engineering feats, the harnessing of the Falls is no child's play and the constructors have had their hands full all the time. All of the work has had to be done by coffer-damming, but even though these dams have been high and steam pumps have been employed, the Falls has contested every inch. Throughout the winter and this spring the contractors have had innumerable delays because of high water and on several occasions much of their timber has been washed down stream.

For convenience, and with the idea of better controlling the stream, the east duct was built and after it had been carried down stream several hundred feet, work on the other ducts began, all of the water being sent through the east duct. This method has been pursued as much as possible although, at certain points, it was necessary to shift the stream from one side to the other. That there is but 75' of space in which to work, and that it is necessary to have dry bottom to lay the bottoms of the ducts has greatly hampered the contractors.

While the granite retaining walls of the stream are solid, the ducts are being built independent of the side walls, using them more as frames than as supports. The side walls of the conduits are each 2' thick at the bottom and the top varies from 27" to 35". Reinforcing steel is liberally used, the rods being in square bars and varying from ¼" to 1¼". In the walls the vertical bars are ⅝-in. spaced 7¾", while the longitudinal bars are ¼-in. spaced 2' to 3' o. c. The bars in the top are 1¼-in. spaced 7¾" and there are also ¼-in. longitudinal bars on 2-ft. centers. The bars in the bottom are ¾-in., spaced 15½" and the longitudinal bars are ½-in. spaced 12".

The east duct has a brick invert, one brick deep, but the bottoms of the other ducts are of concrete.

Real estate men are not all given to unreliable statements, common opinion to the contrary notwithstanding. Witness the following: An enterprising agent, endeavoring to sell houses in a subdivision, wound up his appeal with this refreshing truism: "Two frame houses for sale at a bargain. *Will not last long.*"

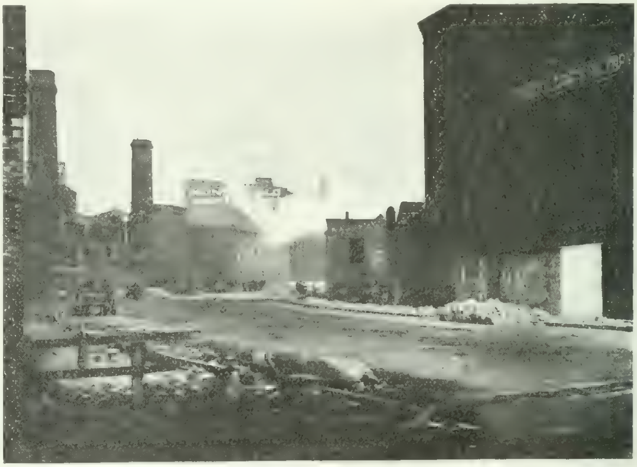

Fig. 5—The Conduit Completed and Paved and Used as a City Highway

This is essentially the same view shown in Figs. 2 and 3 as indicated by the distillery building and the two square chimneys at the left in Fig. 2 and at the right in Fig. 3

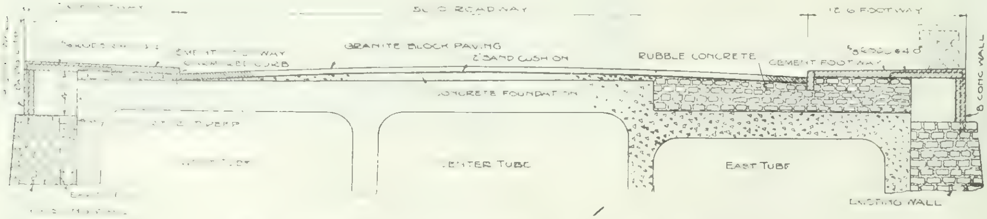

Fig. 4—Section of Concrete Conduit Over Jones' Fallsway, Baltimore

Carlinville Concrete Road Cost Data

BY A. N. JOHNSON*

The Burke Lane improvement began at the western edge of the C. & A. Ry. right of way in Carlinville and extended along what is known as Burke's lane for a distance of 3,000'. The soil is a black loam, and the road was fairly level, but thickly shaded and had been one of the worst roads in the community on that account. It had been filled in places with stone, brick and cinders, making what little excavation that had to be done rather expensive. The improvement consisted of a concrete roadway 16' wide and 6½" thick. Crushed stone for the concrete was furnished from the southern Illinois penitentiary and sand was hauled from a creek west of Carlinville. The method of construction was as follows:

The roadbed was shaped to a proper grade, which was so firmly compacted that rolling was not necessary. As soon as the roadbed had been shaped, the sand and stone were hauled upon it in such quantities as would just make the concrete required. Prior to hauling the materials, the concrete machine was placed at the far end of the road. Along either side, boards 2" x 6" were set on edge with their tops adjusted carefully to the proper elevation. Water for the concrete mixer was supplied by a temporary pipe laid alongside the road, in which were openings about every 250 ft., to which hose could be attached, the water in this case being obtained from the city supply at Carlinville. The concrete was mixed in proportion of 1:2:3½. As fast as the concrete was mixed and dumped upon the roadbed, it was shaped by a template, moved along the side forms as a guide. The finishers, working from a light bridge[1] laid across the road, removed any imperfections in the surface which was, after a few hours, marked crossways with a heavy stable broom. As soon as could be done, a canvas was laid across the concrete and kept wet and the next day the surface was covered with earth which was thoroughly wet and kept in a moist condition for about two weeks.

[illegible]

An important feature of the work consisted in constructing under the edge of the concrete a longitudinal ditch about 6 in. or 8 in. deep, which was filled with crushed stone. From these ditches running under each edge of the concrete there extended laterally stone filled trenches to the side ditches, these lateral drains being constructed in such a way that the water would drain from the roadbed to the side ditches. The object of these lateral drains is to prevent seepage, beneath the edge of the concrete at the shoulders, of water falling upon the concrete road.

From the C. & A. tracks for a distance of about 800 ft. westerly there was a newly constructed sewer trench. As the material in this trench had not had time to settle, the concrete road, where it spanned this trench and the lateral sewers leading from it, was reinforced with ½-in. twisted bars 6' long spaced 12" apart.

Expansion joints were placed every 50' and consisted in part of wood paving blocks and in part of steel plates manufactured for this purpose.[2] The spaces between the plates were filled with tar

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*Illinois State Highway Engineer.

[1] This bridge is really of the suspension type and is shown in Fig. 5—quite different in construction from most bridges used for this purpose. There seems little likelihood of its sagging into the concrete [illegible].

[2] R. D. Baker & Co. plates, placed in pairs between sections and filled between with an [illegible]. One of these joints is shown in Fig. 3.

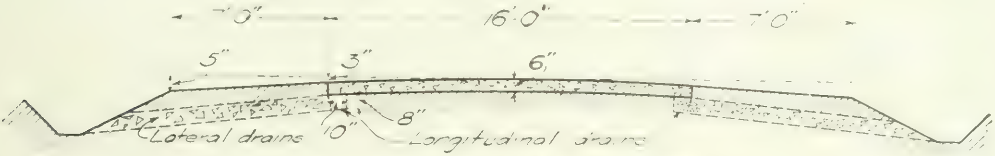


Fig. 1—Cross-section Carlinville, Ill., Concrete Road

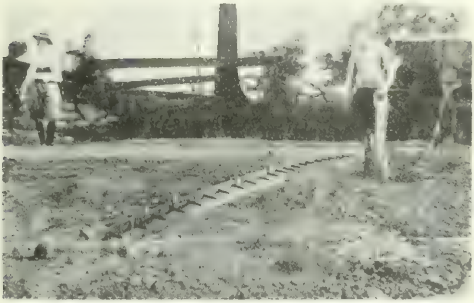


Fig. 3—Steel Plates Assembled and Set in Place on Subbase

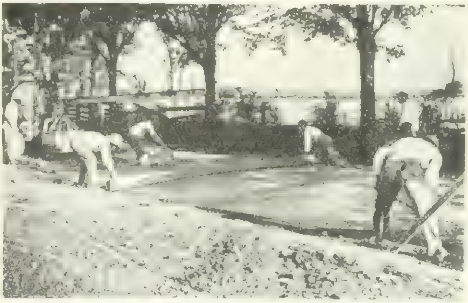


Fig. 4—Striking Off Surface of Pavement to Give Proper Crown

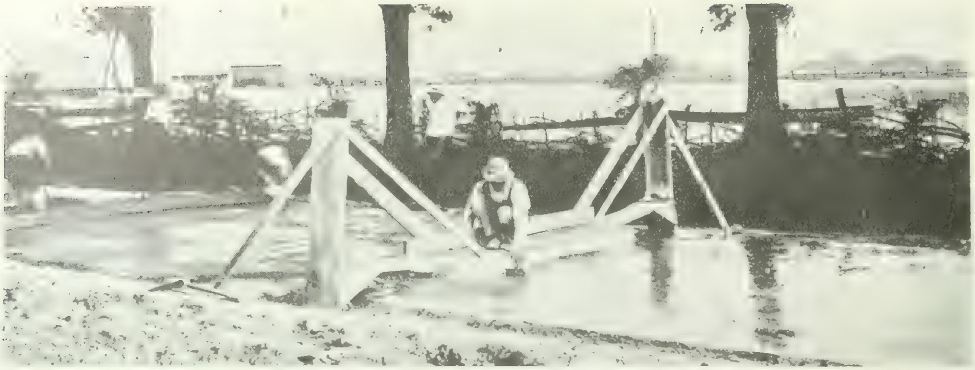


Fig. 5—Bridge Used to Keep Finishers Off Concrete

paper. The joints were not placed at right angles with the line of the road, but at about 60°, the object being to afford the least possible inconvenience to traffic due to any unevenness that might exist at the joints.

The expense for the improvement was paid from a special fund raised by subscription by a committee of citizens representing property along the road.

The following table is an itemized statement of the cost of the road:

Amount of pavement laid	7,111 sq. yds.
Thickness of pavement	6½″
Width of pavement	16′
Length of haul for materials: sand	1½ miles
stone	1½ miles
Cost of cement per bbl. f. o. b. Carlinville	0.98
Amount of cement used per sq. yd. of pavement	0.33 bbl.

Cost of Labor and Supplies

Superintendence	$ 157.50	
Excavation	591.73	
Shaping road bed	108.70	
Loading and hauling sand and stone, including rehandling	795.05	
Mixing and placing concrete	700.58	
Watchman and miscellaneous labor	131.46	
Cost of sand and stone f. o. b. (stone freight only, sand free)	741.00	
Cost of cement f. o. b. Carlinville	2,307.90	
Expansion joints	112.40	
Reinforcing steel	100.00	
Coal and oil for mixer and miscellaneous supplies	25.00	
Forms and other lumber	31.75	
Total		$5,803.07

Cost Per Square Yard for Labor and Supplies.

Superintendence	$ 0.0220	
Excavation	.0840	
Shaping roadbed	.0153	
Loading and hauling stone and sand, including rehandling	.1120	
Mixing and placing concrete	.0986	
Watchman and miscellaneous labor	.0184	
Cost of sand and stone f. o. b. (sand free at pit)	.1050	
Cost of cement f. o. b. Carlinville	.3246	
Expansion joints	.0156	
Reinforcing steel	.0140	
Coal and oil for mixer and miscellaneous supplies	.0034	
Forms and other lumber	.0047	
Total		$ 0.8176

A Demonstration Road of Many Different Types

A demonstration highway constructed by the different companies building improved roadways in the Pacific Northwest is under construction just outside the city limits of Olympia and when completed will be one of the most novel highways ever constructed. As yet road building is, to a great extent, in the experimental stages and the road of many varieties now being built will go to a great length, it is believed, in solving the problems, or many of them, with which all municipalities are confronted at the present time, when they begin to think of improving traffic conditions within the city limits or contemplate good roads in an effort to bring the farmer in closer touch with the city.

The plan is evolved by Dr. P. H. Carlyon, state senator and one of the leading men in the Olympia Chamber of Commerce. The Olympia chamber has taken charge of the work and now the project has grown in proportions which far exceed the fondest desires of Dr. Carlyon and the chamber.

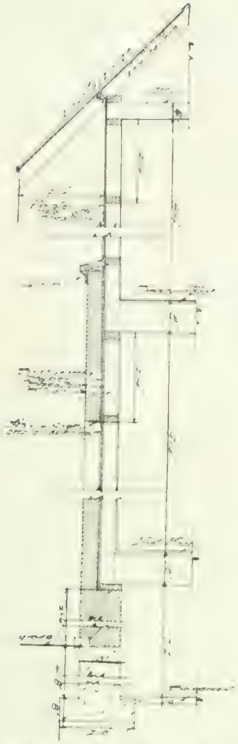
Every company building any kind of roadway is invited to participate in the construction of the highway, thereby demonstrating to the northwest by an equal, fair and severe test the merits of its products as compared with rival companies. The county commissioners of Thurston county have agreed to do all necessary excavating and will furnish the crushed rock necessary for rounding off the sides, and at the same time they will provide the proper drainage.

Highway Commissioner W. J. Roberts, who has headquarters in Olympia, has agreed to have a member of his staff superintend the work and will keep the specifications, together with all other data, such as cost, dates, maintenance, etc., on file in his office in order that any who desire official figures on different portions of the road can secure the same first hand from the state. The highway is being constructed on the Pacific Highway and starts near the city limits of Olympia and runs toward Tumwater, two miles south. All companies are required to build their stretch of road 16′ wide and at least 100′ long. Several have already signified their intention of building 100′ of road, but the Delaware Paving Co., Seattle, and the Association of Western Portland Cement Manufacturers, with headquarters in Portland, have each reserved 400′.

As soon as the road is completed, the Olympia Chamber of Commerce will write every city council and every board of county commissioners in Washington, calling their attention to the road and inviting them to inspect the different kinds of material used and avail themselves of the opportunity to secure the data regarding the different sections of the highway before they decide on any particular kind of paving.

Plans have been completed by which all of the hard surface paving will be laid on one stretch and the macadam and other like varieties in one section. It is understood that the Portland cement interests contemplate an active advertising campaign after their stretch of road is completed, calling attention to the demonstration highway, and will bring people from all parts of the Northwest to inspect it.—*Southwest Contractor and Manufacturer.*

Indications are for a somewhat higher price for Portland cement this year.



Wall Section—Scale [illegible]

Concrete Brick Veneer and Stucco House

BY JENS C. PETERSEN

Designs published herewith illustrate a house 28' wide and 43' deep, including the front porch.

This house will be suitable for a narrow city lot, and the exterior is both pleasing and effective. The lower story, to the height of the belt course at the base of the second story windows, is of concrete brick veneer, and the second story rough-cast plaster on metal lath, while the roof over the main building and porch is of asbestos shingles.

Rooms are well arranged, large and convenient. The reception hall and the living room are divided by square columns on pedestals, as shown by the floor plans. The kitchen and the dining room adjoin, and a good sized pantry is arranged off the kitchen, as are also the back porch and the stairway to basement and grade entrance. Adjoining the dining room is a den with a closet.

On the second floor are three bed rooms, each with separate closet, one open air bed room with closet, and a bath room and a linen closet off the hall. There is a stairway to the attic, which could be entirely floored over and used for bed rooms if desired.

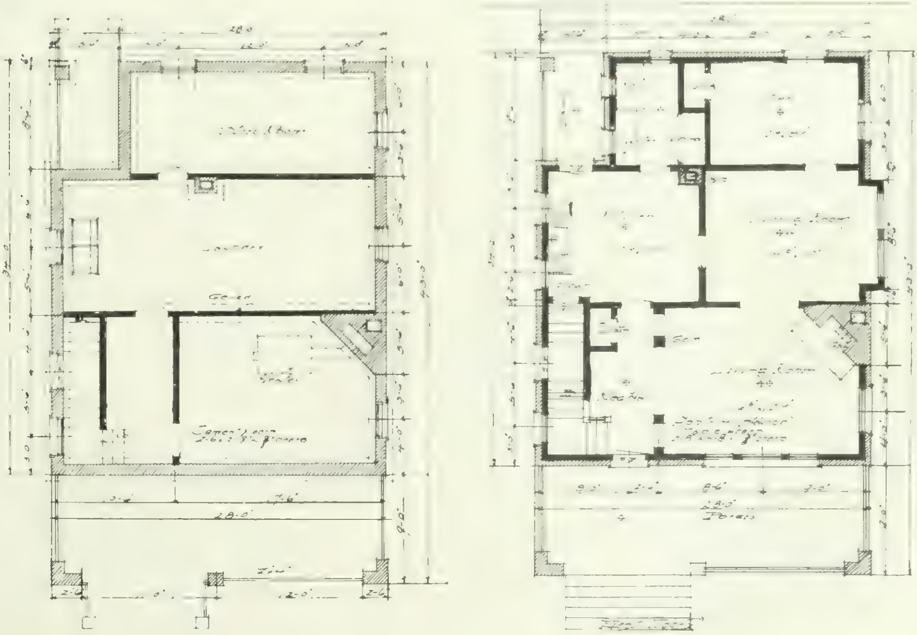
The fireplace in the living room is built of brick, has a wood mantel shelf, and is plastered above.

Ash trim makes a good finish for the first floor, and Georgia pine will be suitable for the second floor, all of this to be stained, shellacked and waxed.

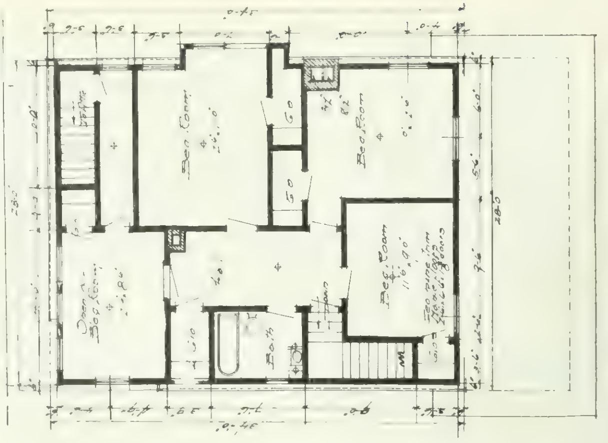
The cost will approximate $2,400, without heating and plumbing, and is itemized as follows:

Excavating		$ 40
Masonry		1200
Rough Carpentry		400
Finish wood work		200
Plastering		160
Painting		200
Hardware		60
Fire Place		40
W[illegible]		4[illegible]
Fixtures		60
		$2400
Heating	$165	
[illegible]	2[illegible]0	
	$365	365
		[illegible]

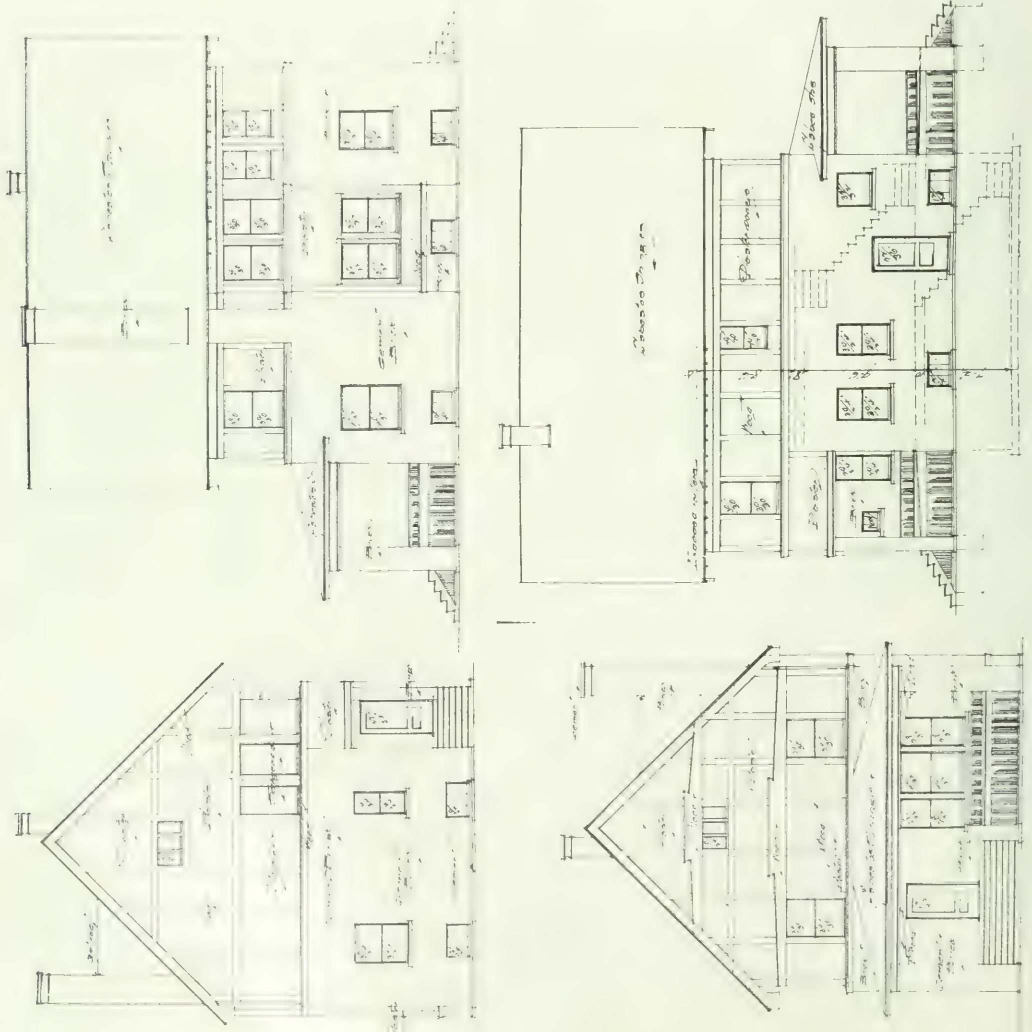
La Salle Township, Ill., where there is a lively interest in concrete roads, will construct a 20-ft. concrete roadway across the Illinois river bottom. One hundred cars of gravel and sand and 20 cars of cement are required for the road. A. N. Johnson, State Engineer of the Illinois Highway Commission, will supervise the work.



Basement Plan—Scale 1/12" to 1'—First Floor Plan



Rear Elevation, Side Elevation
Front Elevation, Side Elevation and Second Floor
Plan Concrete Brick Veneer Frame
House. Scale 1 16" to 1'



Information and Consultation

The Questions and Discussions in this Department are of interest and real value. Speaking for our questioners, we earnestly ask readers to discuss the questions submitted. For men in field and office, let this be a real consultation

section, an exchange of ideas, among those who have, and those who have not, solved some of the problems of structural concrete. Questions and Discussions are cordially invited.

280. Waterproofing a Boiler Pit

"I have a piece of work that a client wants me to keep the water out of. The water seeps through the brick and runs about 15 buckets an hour. How thick ought this to be plastered? What kind of waterproofing, if any, would you suggest to use? This is in a boiler pit and it is so low that it cannot be connected with the sewer. I believe that there is a spring opened close by."

280. DISCUSSION BY C. W. BOYNTON*

From the information supplied, we judge that this boiler pit is below the ground water level and the walls are therefore subjected to pressure due to a hydrostatic head. If the leakage comes through joints in the wall due to permeable construction, it should be possible to make the wall watertight by applying a plaster coat. If the leakage is due to cracks caused by pressure, a plaster coat will be of no avail and it will be necessary to build an inner wall of concrete.

If it is decided that the leakage is due to the first mentioned cause, the following procedure is suggested: Determine the source of leakage through the wall, by sopping up the water on the surface with a sponge. If the leaks are confined to certain points, stop these up until no flow exists; or, if this is impossible, insert a piece of pipe about ½-in. in diameter, into a hole drilled into the wall where the leak occurs The leakage may be confined to the tube by cementing around its outside. Carry the flow from the tube clear of the wall by means of a rubber hose. When all of the leakage has been taken care of in this manner, the surface of the wall should be prepared for plastering by a thorough cleaning. All dirt, grease and soot must be removed, chipping off the face of the wall if necessary, and all joints in the brick work should be dug out to a depth of about 1 in.

Before plastering, the wall should be wetted until it has absorbed water to its full capacity. The surface should then be painted with a grout of Portland cement and water, mixed to the consistency of thick cream. The grout should be applied with an ordinary brush, taking care not to work so far ahead of the plaster that the grout will have time to dry before the first plaster coat is applied. The grout should never be used after it is 45 min. old.

The first plaster coat applied on the moist grout should be about ⅜-in. thick and mixed in the proportion of 1:1½, using standard Portland cement and a well-graded, clean, coarse sand. The proper consistency is best indicated by the ease in application and, like the grout, no more plaster should be mixed than can be applied within an hour.

The application can be made with a steel trowel, but the mortar should subsequently be worked thoroughly as soon as possible with a wooden float, so as to insure a dense and impervious coating. When partially hardened, the surface should be scratched "criss-cross" with a coarse saw blade or similar treatment given so as to give a good hold to another coat of the same kind of plaster, applied in the same manner as above, but before the first coat has dried out. To insure a good bond, it is well to wet the surface with a brush, mopping off any excess before applying second coat.

After floating with a wooden trowel, the plaster should be finished with a steel trowel which should assure a smooth, impervious surface.

The plaster must be protected from too rapid drying out, and after gaining sufficient strength, should be kept wet for seven days to permit thorough hardening. Any holes in the wall made to take care of seepage may now be stopped with mortar, and if the work has been properly done the wall should be watertight.

If the measures outlined above fail to stop leakage while work is in progress, a hole may be broken through the floor and a sump made to relieve the pressure from the walls. By pumping from this sump the flow of water may be taken care of until the plaster has thoroughly hardened, when the sump may be filled and the floor repaired with concrete.

If the walls are cracked by the pressure of the water, the use of a sump and pump will be necessary to relieve the pressure. The method of repair then is to reinforce the walls with a lining wall of such thickness that the resulting wall is sufficiently heavy to prevent movement and resulting cracks due to the water pressure.

280. EDITORIAL DISCUSSION, THE ACTUAL SOLUTION

This question was discussed in the Jan., 1913, issue[1] also; stopping leaks in boiler pits seems to be a problem met by a good many builders, and the manner in which this particular problem was solved is briefly described by the builder who did the work:

In regard to the boiler pit that I wanted to stop the water in, will say I excavated around the outside of wall and put on a coat of asphalt. A hole for a sump was dug in the center of pit, and the bottom plastered. Then I plugged the hole, and up to the present time the pit is dry.

* * *

275. Structural Steel Cores for Concrete Building

"In some of the more recent work structural steel shapes are used extensively for column cores.

In our modern city buildings where the floor space on the first floors is valuable, the steel column undoubtedly presents a very economical and efficient construction. We would like to know (a) What is the best steel shape to use for a column and (b) What is the best connection between the reinforced concrete girder and the steel column to take care of the excessive shear?

275. DISCUSSION BY WILBUR J. WATSON*

In regard to steel reinforcing for columns, I prefer the use of the Gray column, as it is much easier to carry the continuity bars through this column than for any other type with the exception of the column formed of four angles latticed on four sides. This latter type is a rather expensive one and connections are difficult.

Our practice is to use shelf angles for connection of reinforced concrete girder to steel columns, figuring the shelf angle of sufficient capacity to take the entire shear. As a general rule, we figure the steel reinforcing of sufficient section to take the entire load considered as a short column—that is to say, using a high unit stress, about 16,000 lbs. per sq. in.

275. DISCUSSION BY M. C. TUTTLE†

Relative to the best form of structural steel columns, we have thought that the lattice column which we have used on several engineers' designs was particularly good for this type of building, because the rods could be passed through the column between the latticing and the center of the column was solid concrete. The support for beams has usually been furnished by a heavy bracket and with the adequate and proper support, and to take care of the shear readily.

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*Engr. in Charge, Information Bureau, Universal Portland Cement Co., Chicago

*Cons. Engr., Cleveland

†Sec. Aberthaw Construction Co., Boston.

[1] Page 24

275. Discussion by John Stephen Sewell*

I have for a long time been convinced that a reinforced concrete column as compared with a steel column, adequately fire-proofed, is of very doubtful economy. A theoretical consideration of the question, including a discussion of all tests that seem to bear upon it, convinces me that the most economical type of commercial structure, all things considered, would have steel columns filled and covered with concrete, supporting reinforced concrete floor systems. This statement I regard as correct within ordinary commercial limitations of cost. If it is a question of the greatest physical efficiency regardless of cost, the most desirable type would almost certainly be materially different.

So far as the form of the column is concerned, it ought to be one which can be easily filled and covered with concrete. It also should afford a passage between its main members at the floor levels, with a view to making the reinforced concrete girders continuous. This would not necessarily exclude narrow batten plates to be incorporated in the concrete of the girder, but there would have to be free passage for the girder reinforcement. The girders should be designed and built for complete continuity. They should be supported by large brackets on the columns. The beams would probably better be laid out so that they would not intersect the columns at all, thus avoiding the necessity for any column connection except those pertaining to girders. The above requirements would seem to indicate columns made of two channels placed back to back suitably and adequately connected by means of latticing or batten plates. This is apparently the most promising type of column, but no doubt others could be devised. (e. g., four angles, back to back). Neither the continuity of the columns in a vertical direction nor the continuity of the girders in a horizontal direction should be sacrificed. With a column complying with the above conditions, both of these important features can be preserved.

In speaking of the relative economy of fire-proof steel columns and of reinforced concrete columns, it is assumed that both types would be designed for the same factors of safety under both loading and fire tests and on an equally conservative basis of design; much of the reinforced concrete work of the present day is not so conservative as it should be.

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*Gantts Quarry, Ala.

281. Tanks for Vegetable Oil

"We have in mind building a tank about 48 ft. long, 7 ft. wide, and 6 ft. deep for the purpose of holding linseed oil, and are very desirous of getting all of the information that we can concerning the advisability of using concrete for this purpose. The tank will contain about 200 gals. and will have a division wall across the middle.

"The tank will be exposed about 3 ft. out of the ground. It is our intention to give this two coats of cement paint and one coat of enamel on the inside. If you can give us any information concerning this, we would appreciate it."

281. Editorial Discussion

The following item, translated from *Zement und Beton,* was referred to in *Cement Age* for Feb., 1912, and is quoted here as bearing directly on the question:

An Austrian plant uses a reinforced concrete tank without any special lining except an ordinary cement finish in the proportions 1:1:5. Recent tests have shown that the fatty ingredients in the animal oils are dangerous to cement. The sebacic acid found in all animal oil, while not in itself strong, has a destructive influence on cement when allowed to attack it in large quantities and for a considerable time. The best cement finish for oil tanks is about 0.8 in. thick, and composed of the best Portland cement, and a clean, sharp, fine-grained quartz sand, mixed in the proportions 1:2 and 1:3. Wherever the inner surface of the tank shows quartz sand particles, the sebacic acid will form a gelatine-like layer of silicate, and will fill the pores of the cement finish, preventing any penetration of the acid. The concrete should have set thoroughly before the cement finish is placed, and the same holds true for the finish before filling the tank with oil.

281. Discussion by R. A. Plumb*

I would advise against the application of concrete for tanking vegetable oils. Practically all vegetable and animal oils are saponifiable in contact with alkali and there is considerable opportunity for the calcium hydroxide naturally present in the concrete to saponify the linseed oil, forming calcium salts of the organic acids characteristic of this oil, manifesting an internal disruptive force that would develop a slow surface disintegration.

I do not consider it practical to protect the concrete by the application of 2 coats of a cement paint and enamel, as suggested in the inquiry. Although any paint coating resulting in the oxidation of a drying oil is much more immune to solution after oxidation, yet it will in time be softened and its effectiveness as a protective coating will be entirely lost.

Concrete would be a very excellent material to employ for the structural strength of the tanks, but they should be lined preferably with metal, to protect the concrete from direct contact with the saponifiable oil.

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*Trussed Concrete Steel Co.

294. Waterproofing An Old Roof

"Owner has 2-story brick building, 25'x130' roofed with 4-ply tar and gravel. About three years ago he put on a new roof, which is leaking badly. As he is tired of having to pay repair expenses every year, he made me a proposition to put over the old roof a coat of cement topping, say 1:2 mix, 1½" thick, trowel finished, with ¼-in. expansion joint every 4' and parallel to outside wall. The expansion joint is to be filled with bitumen. Will this roof be serviceable? The owner doesn't object to cost as long as the repair expenses and damage by leaking are avoided. The roof has ¼" per ft. fall."

294. Discussion by Chas. G. Ruess*

The method above proposed certainly would not make a serviceable roof. Assuming the roof of the building to be of wood, a cement covering of the thickness mentioned would crack up in a very short time, as there would be no bond between the wood and the cement. The same thing would happen if it were laid upon the present 4-ply tar and gravel covering, which being waterproof, would not absorb the excess moisture from the cement as is the case when laid upon concrete, therefore hindering the natural setting of the cement. By laying 4 ins. of cinder concrete on this roof, finished with 1 in. of waterproofed cement mortar, applied as directed by the manufacturer, an absolutely watertight job could be obtained, but we do not recommend this method, as this form of roofing is very heavy, cinder concrete alone weighing from 100 lbs. to 110 lbs. per cu. ft., and we doubt if the structure is built with roof beams strong enough to support this extra dead weight.

If, however, this building has a concrete roof, it would be a very simple matter to cover it with a waterproofed cement coating, but it would not be necessary to leave expansion joints closer than every 25 ft.

We do not see any reason why a tar and gravel roof laid by a responsible roofing contractor should not prove satisfactory. Roofs of this nature are laid extensively in this city, and in fact in all the large cities of the country, and last from 10 yrs. to 12 yrs. with but very few repairs.

294. Discussion by R. A. Plumb†

The best recommendation which we could submit would involve the superimposing of a waterproofed plaster coat to a total thickness of 2", reinforced with a coarse chicken mesh wire, together with expansion joints to accommodate normal expansion and contraction.

The coarse chicken wire which we have recommended as a light reinforcement should be attached securely to the roof at intervals, so as to be certain to hold the slab tightly and inseparably fastened to the surface.

In addition to the expansion joint

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*Bitu-Mortar Co., N. Y. C.

†The Trus-Con Laboratories, Detroit

running continuously around the edges of the roof, we would suggest that an expansion joint be placed directly in the center, so as to be certain that there is plenty of opportunity for necessary movement due to thermal changes.

We would recommend that the plaster coat applied over the roof be a 1:2 mortar, tempered with water to which a good waterproofing has been added. This should insure a perfectly non-absorbent and impermeable plaster coat which in the absence of any cracks would make a perfectly water-tight roof.

The above suggestions assume, of course, that the present construction of the roof is sufficiently heavy to accommodate the additional dead load that would be contributed by a 2-in. plaster coat over the entire area.

Asphalt-Asbestos Expansion Joint: As an expansion joint cement, a good grade of asphalt with a moderate melting point is a good material to use and when the product is melted it is good practice to add a small quantity of coarse long-fibered asbestos to serve as a toughening and strengthening agency for the asphalt and avoid any tendency that might occur for the material to run and flow under the hot sun, in the event that the melting point was not high enough.

A great deal of the success of such treatment depends upon the care with which the joints are cleaned out and thoroughly primed with a thin asphaltum paint, before they are filled with the joint cement composition. Every precaution must be taken to leave no opening or crack between the joint cement and the concrete, through which the water might slowly seep, particularly on a roof with such a small slope.

295. Roughening Walls for Stucco Finish

"What degree of roughness is necessary on the surface of a concrete wall for the perfect adhesion of a plaster or stucco finishing coat? Supposing the forms were lined with wire screening of about ½-in. mesh so that when the form was removed the entire surface would be chipped? Would that be sufficiently rough or would it be necessary to have the surface scored with dovetailed scorings to insure a perfect bond?"

295. Discussion by A. Morgan Smith*

Roughening the wall surface is of some advantage, but proper application of the stucco is more important. As a rule, plasterers throw on the first or scratch coat as they do on lath where a key is formed to do the holding. Plastering on a concrete surface requires care on the part of plasterer. *For stucco to adhere to a concrete surface it must bond with the concrete and thereby depend upon adhesion and not [illegible]*

Where the wall is rough the plasterer has no trouble in making the stucco stick and it goes on very rapidly; it is partially keyed on, there is little effort to bond and friction alone is holding the stucco on. Small cracks, water and variations in temperature will invariably cause the plaster to loose its hold.

To make stucco stick, I would apply about as follows:

When the walls are dried out, or "bone dry," merely sprinkling with a brush is not sufficient; the wall must be saturated and kept damp for a day at least before plastering. This will also thoroughly clean the wall, which is very important.

The "scratch" or first coat should be 1:2, cement and sand. It should be rich. In the final finish, 1:3; there is danger of having it too rich.

I have not had experience with wire screen but believe if sloppy concrete were dumped against the wire mesh it would be embedded very slightly.

When plaster is applied to a dry wall, the water is immediately absorbed from the plaster, which makes bonding impossible.

A lack of bond is easily detected by a hollow sound when tapping with the knuckles on the plaster after it has set.

In fact, the less amount of plaster put on the better. For a rough effect a good plan is to apply a thin coat merely to cover form markings, and when this has set just enough (which is easy to determine when on job), rub over the surface with a piece of carpet.

I sincerely hope the day is not far off when we shall all be satisfied to take concrete as its comes, right out of the forms, or perhaps crandalled.

In appearance, concrete improves with age; after it has weathered a few years, the irregularities blend together. Sandstone and the finest marble both show apparent imperfection but they pass very favorably; so I think will concrete, some day.

295. Discussion by Benj. A. Howes*

I think the method described gives the best possible anchorage for a finishing plaster or stucco coat. No other method I know of gives such good results at any cost. The wire mesh should be placed far enough from the forms so that when the surface is stripped, all the surface in the area between the wires of the mesh will be stripped instead of the wires pulling out without lifting the entire surface. Their minimum distance as I remember is about ⅜ in.

In the construction of a large mausoleum at Morristown, N. J., I used this method with perfect satisfaction to roughen the soffits of the reinforced concrete vaulting to receive the Portland cement plaster coating. Some very elaborate mosaic work in glass and marble was bedded in this cement mortar.

295. Discussion by C. R. Knapp*

Relative to roughening walls for stucco finish, my experience has been that where I decreased my spading by at least 75% on that side of the wall where stucco was to go, the surface presented enough voids and roughness to give the stucco a perfect bond. Furthermore, when the stucco is put on, the walls should be thoroughly wet. This also applies to plastering on the inside.

It would be my opinion in view of my experiences that the use of mesh wire next to forms or dovetailed scoring strips would be an unnecessary expense for labor and material.

296. Drilling Concrete for Sprinkler System

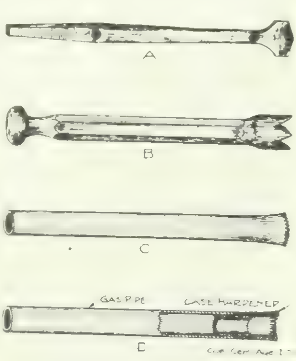
"We are equipping a large reinforced warehouse with a sprinkler system. The concrete was poured about a month ago, but due to the alternate freezing and dampness, the concrete is not hard. When we attempt to drill the ceiling, fine particles gather and stick to the drill so thick that it is difficult to pull the drill out, or to continue drilling.

"We could drill about ½-in. and then pull the drill out and clean it, then repeat, but this costs too much and is too expensive in time. How can we get around this difficulty?"

296. Discussion by J. D. Carey†

To drill concrete, use a drill that has plenty of clearance. If a rotary drill is to be used, it should be the old fashioned forged type as in *A;* otherwise use type *B* or *C* in drive drills. Ample clearance is essential.

A simple gas or steam pipe upset at cutting end and teeth filed thereon and case hardened is shown in type C. For a great many holes the gas pipe drill can be made as shown in *D*.



Note that the tool steel cutter is turned with a slight taper inside and out to give clearance, so that all that is necessary to sharpen cutter is to anneal and file, then temper again. *C* and *D* are the most desirable for concrete.

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*Architect, Mt. Lebanon, Pa.

[1] The italics are ours. Mr. Smith states emphatically what is to some extent overlooked. In applying stucco or plaster coat to concrete walls, every effort should be made to get real union of the materials.—Editors.

*Contracting Engr., N. Y. C.

*Albany, N. Y.

†Concrete Contractor, Cleveland

Some steam circulating through under concrete should set it up, and develop more hardness within a short time.

296. Discussion by Edward A. Weiland*

A pipe drill should work. This is made of a length of ordinary pipe with a case-hardened piece fitted in one end as shown in the accompanying sketch (*D* of the illustration). This works like a core drill, and allows the loose stuff to come up inside.

296. Discussion by J. Wm. Moffett†

It is very difficult for us to conceive of a concrete floor in the condition indicated by the above inquiry, assuming that the form work has been sufficiently removed for the sprinkler people to do their work. It would seem to us that there is considerable danger of much more serious difficulty than that with which the sprinkler people have met. We would suggest that they have a competent engineer make a careful inspection.

297. Building Concrete Houses

"We are figuring on 15 5-room cottages for a local coal company. Concrete walls and partitions are specified. There will be about 35 cu. yds. of concrete in each house. The walls are 10' high and the chimney may go 20 ft. The equipment on hand consists of a small batch mixer and engine. We would like some suggestions regarding forms and a method of elevating the concrete that will not require a lot of machinery, and that can be easily moved."

297. Discussion by C. R. Knapp‡

If the walls are only 10' in height, it would be cheapest to build the forms to full height of wall, using 2" x 4" uprights 16" o. c., and ⅞-in. boards. For this use t. and g. is preferable to shiplap.

The equipment of small batch mixer is all right. For elevating, a slater's wheel can be used. This is easily moved from place to place. I have found coal hods the best to put the concrete in. This is a simple outfit and very efficient unless a spouting arrangement can be installed. I would suggest that the forms be made permanent and in as large units as can be handled in order to work through for the entire 15 houses.

* * *

298. Gelatine Molds

"What is a good formula for gelatine to be used in making molds to produce ornamental concrete which has deep under-cut?"

298. Discussion by Julius C. Loester**

For a gelatine mold for concrete casts, there should be used a good grade of gelatine, boiled somewhat thicker than for use of plaster casting and of a uniform thickness of about 1 in. all over the model. When the mold is taken off from the model, it must be dusted out with French chalk or talcum powder to remove all grease; then a saturated solution of alum is applied with a brush all over, to harden the surface of the gelatine. After the alum is dry, varnish the mold all over with a high grade spar varnish. The best is none too good, considering that the mold is filled up with liquid concrete for weeks, each cast requiring under the most favorable conditions 24 hrs, and is filled up again as soon as one cast is taken out. When varnished (and the work must be done carefully, so that the varnish will not fill up all the deep places), the varnish must then be allowed to become perfectly dry or it will stick to the cast. Before making the cast, grease the mold with *raw* linseed oil, to which a small quantity of machine oil may be added. It is very essential to prepare the mold carefully or the surface will become defective and necessitate making a new mold. Cheap grade or old gelatine is not elastic enough and loses its clean surface quickly.

298. Discussion by A. A. Houghton*

For ornamental molds of this character either a good grade of fish or carpenter's glue is used or the sheet gelatine sold for kitchen purposes. Simply soak it in warm water for several hours, until it has softened, then melt over a slow fire or with moderate heat, using a double receptacle, made by placing one pail inside another, the outer one filled with water; this avoids all danger of burning and also serves to keep the melted composition in a semi-liquid state much longer, as is convenient if the mold is not ready for pouring. The mold should be slightly warm before the gelatine or glue is poured; i. e., the outer casing or shell covering the model. By placing both model and casing in an oven for a short time before pouring the glue, the mold will be greatly improved. Where the under-cut is very deep, or where the mold is large, the glue or gelatine mold should be divided, by cutting with a sharp knife, making the divisions through the center of the under-cut or at one side of it, to make easier the drawing of the mold.

Gelatine is secured from two sources, the parings or hoofs, etc., and from bones. These are treated with diluted hydrochloric acid which attacks the carbonates, phosphates, etc., and leaves the ossein or isomer of the skin substance. Another process uses quick-lime to secure the ossein or unrefined gelatine. The better grades are clarified by adding 1% of ammonium fluoride, which causes a deposition of the ligneous matter and also materially increases the adhesive power of the gelatine.

Cost Data on Mixing Concrete for Paving

Four miles of granitoid concrete pavement were built last fall by Pierce County, Wn., under the state's Permanent Highway Act. This is part of an 8-mile stretch contracted for by the county and a part of the Pacific Highway. The use and cost of two mixers in laying base and top course are described by C. H. Sweetser in *Engineering and Contracting*. On half the work done, a steam cube mixer was used and on the other half a gasoline Foote machine. The top mixture was handled by a smaller gasoline Foote machine which operated on planks laid on the base.

The following figures show the labor costs on the two concrete mixers for 30,075 sq. yds. Usually one move of the base mixer was made each day. At times a different apportionment of labor was made, but this was done when subgrade was not far enough ahead or when other delays made changes economical:

Base:

1 foreman at $5.00	$ 5.00
1 engineer at $3.50	3.50
1 man at skip at $2.75	2.75
9 men hauling gravel and sand at $2.50	22.50
2 men spreading at $2.50	5.00
1 man tamping at $2.50	2.50
2 carts hauling at $4.00	8.00
	$49.25

Wearing Surface:

1 foreman at $3.00	$ 3.00
1 engineer ot $3.50	3.50
1 man at skip at $2.75	2.75
4 men hauling granite chips at $2.50	10.00
4 men on wheelbarrows and spreading at $2.50	10.00
2 finishers at $3.00	6.00
	$35.25
1 form setter at $2.75	2.75
1 helper at $2.50	2.50
	$ 5.25

At the last annual meeting of the Amer. Soc. of Engineering Contractors, held in New York, it was decided, among other things, to constitute an Information Bureau through which members of the Society could receive answers to specific questions. The questions submitted will be referred to a member of the Society who specializes in that field, and the answers will be mailed to the member, and then published in the Journal for the benefit of the Society. The "question box" has always been an important feature of the daily paper; and such a bureau, established by a technical society, should be of value. The Consultation-Information department of CONCRETE-CEMENT AGE, which has been conducted along this line for several years, has been a marked success.

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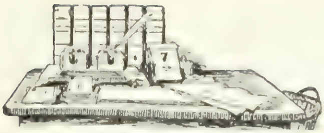
*Contracting Engr., Cleveland

†The Concrete Steel [illegible] Y. C.

‡Albany, N. Y.

**Sculptor, 322 E. 44th St., N. Y. C.

*Detroit, Mich.



CORRESPONDENCE

Bulk Cement and the Mixer

Relative to measuring cement for each batch of concrete with bulk cement and the cost of so handling it as compared with handling cement in sacks, it seems to me that when the work is so situated that the mixing plant can be kept in one place, and the mixer charged from storage bins, measuring the cement should be as simple as measuring any other ingredient. However, when it is necessary to move the mixer from place to place often, then there is greater economy in handling the cement in sacks, the cost of which does not amount to so much as the extra labor of handling it loose, besides the attendant waste.

Partitions in the charging bucket usually used with the side loader are not good. The conditions which we often meet are such that the material does not clear any too well, and the successful machine must work well under the worst conditions. A good means of handling loose cement, where it must be moved some distance from the storage bin to the mixer, is to have a number of cartridges, made of sheet steel, of such size that each will hold the required amount of cement for one batch. Open the cartridge and tip it bottom up into the charging bucket, and add the required amounts of sand and crushed stone, then withdraw the cartridge, which will leave the cement where there will be no loss from being blown by the wind, and the sand and broken stone or gravel will carry it out of the bucket, with very little tendency to cling to bucket, even in damp or rainy weather.

Wm. J. Judd

N. Y. C.

Concrete Fish Ponds

Referring to the correspondence of G. A. Hallinger, West Hoboken, N. J.[1]: cold weather will have no more effect on a properly constructed fish pond than it has on a water reservoir or tank of the same material. The concrete should consist of 1 part best Portland cement; 2 parts fine, clean, sharp sand, which passes a ½-in. mesh screen; and 4 parts clean, coarse gravel or limestone, which passes a 1½-in. mesh screen. Add sufficient water to keep the concrete fairly wet so it flows freely into the plank forms and spade well to all corners, etc., to produce a smooth wall surface without air-pockets. But to begin the work: After the excavation is done within 6" of the rock bottom, dig out for the wall footings down to the rock, and make trenches 20" wide. In this case do not shore with lumber, but let the concrete run freely into the trenches so that it fills all pockets against the rock and clay, which gives a perfectly watertight footing. (See accompanying sketch.)

All clay banks must be covered down to the rock with tar paper or tar felt, and extreme care must be exercised that no dirt or rubbish enters the forms.

After the concrete in the foundation has begun to set a little but while it still is soft, insert the ½-in. round rods for vertical wall reinforcement 18" o. c. Bend the ends over and set the bent piece firmly into the concrete. Secure a 2-in. x 4-in. scantling about 4 ft above footings and wire in the rods to it so that they stand up in a line. No one should disturb the rods until the concrete takes its final set. To guard against the results of expansion use ½-in. round rods horizontally. A wall 6' high must be provided, with horizontal rods crossing the vertical rods every 6", and should be wired strongly to the latter, so that the horizontal rods will not slide and come out of their places when concrete is poured. All rods must lap at least 2' and care must be taken that they do not joint on one spot.

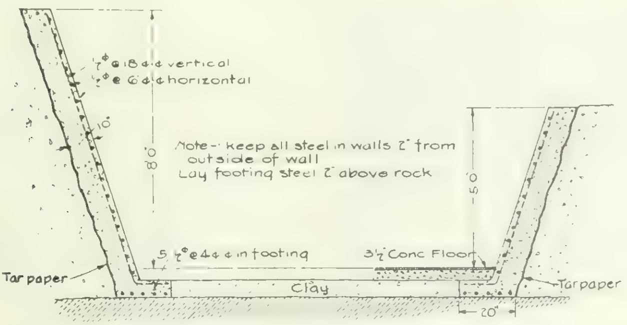
Before running the wall concrete, see that the footings are well covered with the 1:1 mix cement and sand mortar, as this will make the watertight joint between wall and foundation. No other packing, as dirty field stone, etc., should be used in concrete, as this packing done by inexperienced hands will spoil the whole construction. The walls will be 10" thick and have an incline of 65° to 75°. For these, set up yellow pine (no hemlock) planks 2"x10"x12' and nail these to uprights 4"x4" set 4' o. c. Secure the uprights well at the bottom and once more at the center of the wall. All woodwork must be done before concreting is started. In mild weather the plank forms may be removed 48 hrs. after pouring.

The walls complete, clean the bottom of the pond of all rubbish and put in the concrete floor, but give the floor a top dressing, like sidewalk work with a mixture of 1 part Portland cement and 3 parts torpedo sand. The floor should have open joints, in which run hot tar after the floor is absolutely dried out.

Provide a sump hole or drain pit in center or one corner, and have the floor pitch to it; also provide an overflow with fine strainer.

Charles Becker.

506 Morse Ave.
Milwaukee, Wisc.


½"Φ @ 18" c.c. vertical
½"Φ @ 6" c.c. horizontal
10"
8'0"
Note— keep all steel in walls 2" from outside of wall
Lay footing steel 2" above rock
5'0"
5 ½"Φ @ 4" c.c. in footing
3½" Conc Floor
Tar paper
Clay
Tar paper
20"

Cross-Section Concrete Fish Pond

* * *

Transverse Reinforcement for Columns

Referring to the discussion of transverse reinforcement for concrete columns in the Dec., 1912, issue[1], the effort of your correspondent is of little practical value. While the method of transverse reinforcement has great merit, the design must be controlled by the practical conditions that are to be met with in the field. Further, in order to be efficient, the layers of transverse reinforcement must be very close together. It is suggested that your correspondent build a few of these columns and make comparative tests so as to bring out the merits of his design.

It has been stated by a well known authority that in the creative field an engineer can accomplish with one dollar more than the ordinary man can with two. This applies with great force to the design of reinforcement for concrete and in the tests which have been referred to[2], the flat spirals were selected as giving a greater percentage of gain than any other form per lb. of metal used. Keeping this in view, we must analyze the stresses and place our reinforcement in the concrete where it is most needed.

When a block of concrete is subjected to compressive stresses in a testing machine the parts bearing upon the platens are restrained from lateral movement by friction. The influence of this area extends across the whole base and a distance into the specimen. In the case of a cubical block, this results in developing the well-known and characteristic cone failure. The parts of the specimen beyond this influence that are subjected to the vertical strains naturally flow in the line of least resistance; this, in the case of a column, is in a lateral direction at right angles to the axis of the column.

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[1] Nov., 1912, issue, page 64

[1] Page 92

[2] Described in *Concrete Engineering*, May, 1910

The primary object in hooping concrete is to prevent the lateral movement of the granular constituents of the concrete, and incidentally the use of transverse reinforcement is for the same purpose. The application of the reinforcement in the system developed by the writer is that of one or more concentric hoopings or of flat spirals placed at suitable distances apart. Their value has been demonstrated in a number of tests, particularly on those reported two or three years ago to the N. A. C. U. in a paper read at the Chicago convention[2]. At a recent test[3] by the Bureau of Standards in Pittsburgh, the value of this particular reinforcement was clearly demonstrated.

Robert A. Cummings,
Cons. Engr., Pittsburgh.

Centering for Elevator Construction

The accompanying illustration shows in detail the jacking arrangements for circular bin centering referred to in the Jan., 1913, issue, page 41. This arrangement is as follows:

A is a 1¼-in. steel rod with double "V" thread, about 3½-in. pitch.

B is the main jack casting, bolted to the timber yoke.

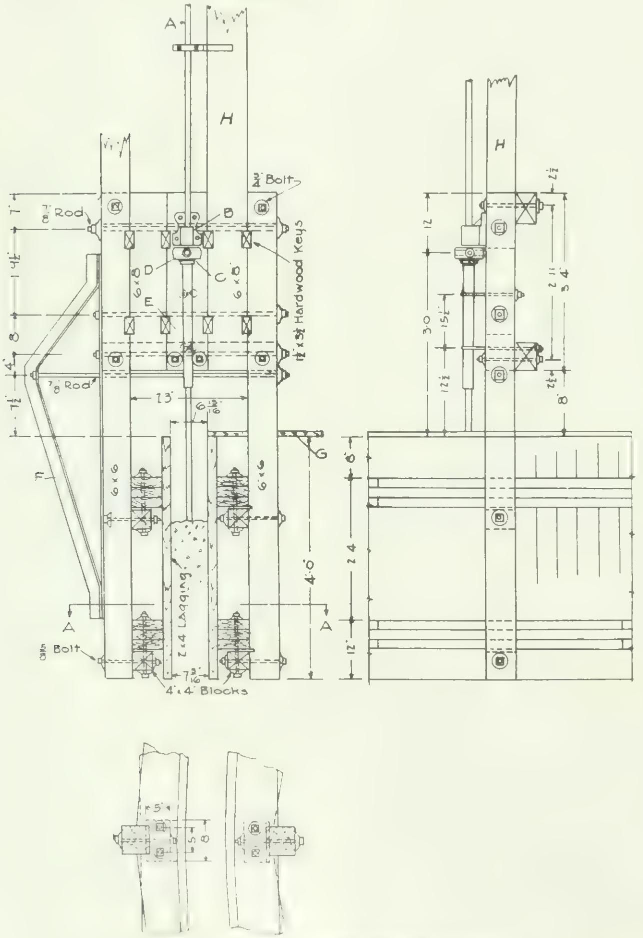
C is a casting which fits over the nut traveling on the rod *A*.

The openings *D* are holes in which iron bars are inserted for turning the nut carriage casting. This casting bears against the main jack casting and raises the yoke to which the forms are attached.

The pipe *E* is used to keep the rod *A* in line and to prevent it from bending.

The angle-iron frame *F* is used on the forms on the outside walls of the building to adjust the bottom of the form and keep the outer and the inner forms separated the proper distance at the bottom. On forms in the interior of the building timber bracing from one form to the other accomplishes this purpose. One of the timbers *H* of the wood yoke is carried up to provide a support for the jack rod and to carry an extra upper structure which we sometimes use as a runway on which to handle reinforcing material. This runway is not, however, always used. In general the only working platform is at *G*.

R. B. Durham,
Vice-Pres. John S. Metcalf Co., Ltd.,
Montreal, P. Q.



[illegible] Arrangement of Centering

* * *

Not a Concrete Failure

The stairway leading to the elevated platform of the Long Island Ry., Nostrand Ave., Brooklyn, was not a concrete stairway in the proper sense of the word. The *Engineering News* of Dec. 26, 1912, gives a full account of the construction of this stairway and of the cause of this collapse. I will not attempt to go into details except to state that the stair consisted of concrete treads and risers supported on steel channel stringers, which were fastened together by tie rods about every 4 ft. These steel stringers rested at the upper end of the flight which collapsed, on steel angles bolted to the fascia plates of the main platform of the railroad station, and at the lower end of the flight were connected, by ⅝-in. bolts, to cast iron newel posts. These bolts rusted and the cast iron cracked and dropped the whole flight to the ground. Of course, the concrete broke up after a fall of some 20 ft.

The failure of this stairway was due to lack of inspection, to lack of painting and rusted steel work which was unprotected. Concrete had nothing whatever to do with the failure.

As far as the "molecular fatigue"[1] is concerned I do not know exactly what they mean by this and do not believe they do themselves, but if they want to connect "molecular fatigue" with constant jar and vibration, they might be interested in some work which we[2] did for J. B. King & Co., manufacturers of plaster, at their Staten Island, N. Y., plant some three or four years ago, where concrete was placed on existing mill construction floors in place in newly built forms[3]. On an adjoining part of these floors were heavy grinding machines constantly operating while the freshly deposited concrete was setting up. After the concrete had set five or six days, the mill floors were removed and the machines from the other parts of the mill floor moved over to the concrete floors and the rest of the mill floor replaced by concrete. Of course, the machines were not moved over until the new concrete had attained proper strength. The point of interest is that from the time the concrete was deposited on the wooden floors until the wooden floors were removed from thereunder the concrete floors were subject constantly, day and night, to a very heavy jarring and vibration. Some doubt existed as to whether or not concrete would set up under such conditions but it was found that this jarring, if anything, improved the strength of the concrete and seemed to settle it together in better shape than is ordinarily the condition. In other words, the jarring was a good thing rather than a detriment.

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[3] Published in the Feb., 1913, issue, page 84

[1] In a recent issue, the *Builders' Guide*, quoting a lumber journal, stated that this accident may have been due to a molecular fatigue of the concrete caused by constant jar.—Editors

[2] The Turner Construction Co., N. Y. C.

[3] Described in *Concrete Engineering*, Sept. 1909, p. 239

As far as jarring and vibration are concerned on concrete that has attained its strength, there is little doubt ordinarily expressed to-day as to the resistance of concrete under vibratory operations. There are so many hundred industrial buildings, a considerable number of which have been constantly subject to vibration, that are rendering good service to-day and so many railroad bridges which are subject to heavy jarring and vibration and yet are giving excellent account of themselves that it is only the extreme skeptic who can doubt the strength of concrete under vibration.

J. P. H. Perry,
Turner Const. Co.,
N. Y. C.

* * *

Concrete Construction in Australia

As building is brisk here and skilled labor scarce, there is a tendency to fly to anything for economy. Although bricks and stone are good and abundant, a variety of concrete buildings is being erected, some solid, others hollow, built *in situ*, poured or rammed concrete blocks, pillars and slabs, etc. * * * * I have had a large residence erected of hollow concrete block with large terraces and balustrades; the entire building is white and has a good appearance, but, of course, is criticised as all things that are a little out of the ordinary always are. It may be of interest to know that Portland cement here is 12s. to 14s. ($2.92 to $3.41) per bbl., 330 lbs. Laborers 10s. to 11s. ($2.44 to $2.68) per day of 8 hrs., carpenters 12s. ($2.92), bricklayers 11s. to 13s. ($2.67 to $3.16), plasterers 14s. ($3.41). The mechanics don't distress themselves by working too hard, so it can be readily understood how people who must have buildings are ready to jump at any notion if they are told it will be less costly, and quite substantial. * * * * The climate here is very dry and I am inclined to think that the floors are not left wet long enough; consequently, the surface begins to fret or sand. I am trying several experiments now, such as oiling, also another coating with silicate and soda. The best cement used here is German or English. We have also cement works on small scale.

F. W. Dancker,
F. W. Dancker & Son, Architects,
Adelaide, Australia.

Sand and Gravel Washing Plants

BY RAYMOND W. DULL*

There has been a very marked change, within the last few years, in preparing materials for concrete purposes. We seldom see the old obsolete method of sending a team out to river bank or gravel pit, for a load of gravel, which is dumped in the aggregate, regardless of size, proportion or cleanliness. We now see a modern factory for handling, sizing and washing the materials. This decreases the cost of handling, prepares it for different kinds of uses, and best of all, makes it most suitable for the purpose.

Unclean material, with poor workmanship, has been responsible for nearly all concrete failures. A contractor who is not particular about his materials is seldom particular about his workmanship. It is useless to buy high grade cement, and mix it with gravel having even a thin film of dirt coating the pebbles, for the cement cannot adhere to the pebbles.

A successful method, used in the modern gravel washing plant, is to agitate the material until the impurities are in suspension in the water, drawing the water off continually, and then rinse the material as it leaves the screens. It is important to leave the water with the material until the last, in order to get sufficient agitation, and that is why separate screens are used for each size.

Screens

The writer, after considerable study, developed and applied for patents on the hook-bolt type conical washing screen shown in Fig. 1. These screens are set in a series (Fig. 2) with spouts carrying the sized material to succeeding screens below, while the rejections from the screens discharge from the mouth of the bell into the bins below. The material gets its rinsing from fresh water pipes at the mouth of the screens. The upkeep of this screen is low, because the bearings and drives are away from the grit and water. The large hook-bolts which support the screen cone do away with all fastenings to the casting, and the screen cones can be changed in less than an hour's time.

I was not however satisfied with the progress which this screen made, and developed a still more radical departure in screen construction. Appreciating the advantage gained if all chain drives could be eliminated, the inclined conical screen was developed as shown in Fig. 3.

All the screens in this development are mounted on one shaft, and one pair of gears drives everything. This type of screen differs in its operation from the other screen, for the material is delivered into the large end and travels toward the small end, while with the hook-bolt type the material is delivered into the small end, and travels toward the large end.

The inclined conical screen has the advantage because the large end does the principal work. The large end has more perforations, more wearing surface, and is in fact, equivalent to a larger screen. It therefore has greater efficiency, requires less power and has small upkeep.

The screens have longitudinal joints, and can be dismantled from the shaft, without disturbing the shaft. Walkways are also provided on either side of the screens, to make them accessible, as shown in Fig. 3.

The largest quantity of water is introduced when the material is first starting into the screens, and additional fresh water is added at each screen. The water supply is a very important detail of the plant, and sometimes success or failure depends entirely on this feature. After the material passes through all the screens, the remaining materials are the soil, water and the sand.

Settling Tank

A device extensively used for separating the sand from the soil water, is a

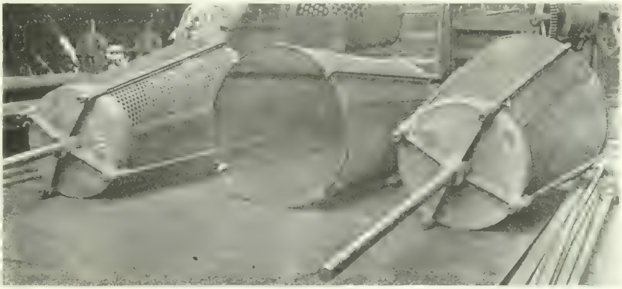

Fig. 1—Detail View Showing Construction of Conical Open-Ended Sieves

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*Aurora, Ill.

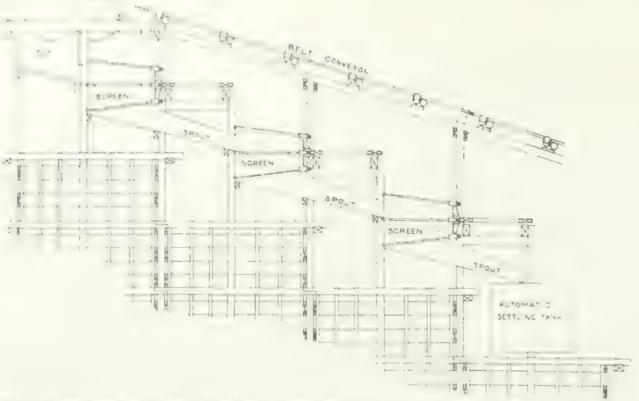


Fig. 2—Elevation of Gravel Washing Plant in Which the Conical Screens are Rotated Horizontally

wooden tilting tank, patented by Charles Stebbins, Chicago. This is shown at the right of Fig. 3. This tank rocks on two bearings on the sides of the tank. It is divided into two triangular compartments, one for the water and the accumlation of sand, and the other compartment for weights, acting counter to the weight of the water and the sand.

The valves of the tank consist of pipes, fastened into the tank, with their ends bearing against a fixed timber. When the sand accumulates enough weight, the tank tilts, drawing the pipes from the timber stop, and allowing the sand to escape into the bins below. When a certain amount of sand escapes, the tank tilts back, closing the valves.

We are using a modified form of tilting tank (Fig. 4.) made of steel, which is somewhat more sensitive, and designed to permit adjustment of the equilibrium. It consists of a triangular shaped tank, rocking on two knife-edged brackets on the sides, and counterbalanced by a lever and weight. The lever is designed to increase the moment arm of the weight, which retards the tendency to tilt open too far, and does not permit flushing of the soil and water into the sand bin below. The valve castings, which have V edges, bear against steel plates, with rubber faces, which are pivotally connected to timber. The operation of these tanks is very gratifying, and results are very satisfactory. When getting rid of the water, it must not be allowed to percolate through the material to drain off. To do this makes a regular filter bed operation, and all the impurities in the water are held in the material.

Some clays will not succumb to ordinary processes, and for these I have introduced what I call a preliminary "scrubber," which is used for materials unusually hard to wash, shown in Fig. 5. It consists of a conical cylinder, shaped in a manner to retain considerable material and water, which tumbles about when the cylinder rotates. This agitation breaks up the clay and the worst part of the impurities is carried off, before the material reaches the screens.

This same device is also used as a mechanical sand separator. In this use, it is hardly so efficient as the tilting tank, and also has the disadvantage that it requires power, but it has the advantage that the sand bin can be made 5 ft. or 6 ft. higher.

Handling Materials

The belt conveyor is almost universally used on the larger plants, for carrying the material to the top of the bins. (Fig. 6.) It is efficient, and if properly installed is very satisfactory for this purpose. Belt conveyors are also used to convey material to the plant from the excavator. Drag-line excavators are also coming into use for plants of moderate capacity. A typical installation is shown in Fig. 7. They have the advantage that one man at the hoisting engine is all that is necessary to elevate and deliver the material to the plant. The plant shown is equipped with a machine which returns by gravity, very rapidly.

Bin Construction

In constructing bins, the skeleton

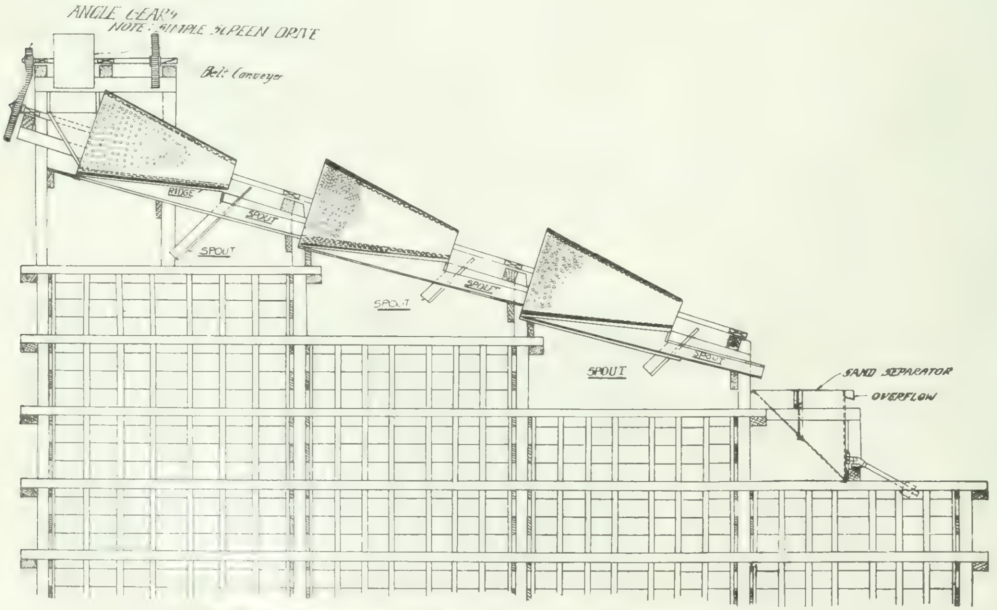


Fig [illegible] Elevation of Gravel Washing Plant Using Inclined Conical Screens construction is preferable to the cribbed construction. The skeleton design can be repaired much more easily, and requires less material to make. Solid plank walls, built up by spiking the planks flat-wise, one upon the other, is what is known as crib construction. The reason that this construction is not desirable is because so much water in the bins remains in the joints between the planks, and rots them very rapidly. If this construction is used, all joints should be well tarred. A few washing plants have reinforced concrete bins. Concrete makes excellent bins, and of course they are more permanent than bins made of wood. Circular steel tanks also make excellent bins. The bin construction is usually a matter of preference with the purchaser.

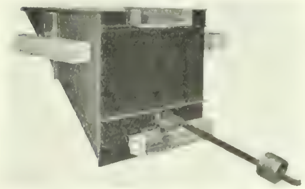


Fig 4 Detail View of Steel Settling Tanks

Fig 5 Detail Elevation of Mechanical "Scrubber" for Handling Clayey Gravels

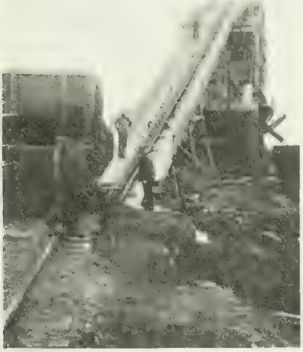


Fig. 6—Belt Carrier Handling Gravel at a Washing Plant

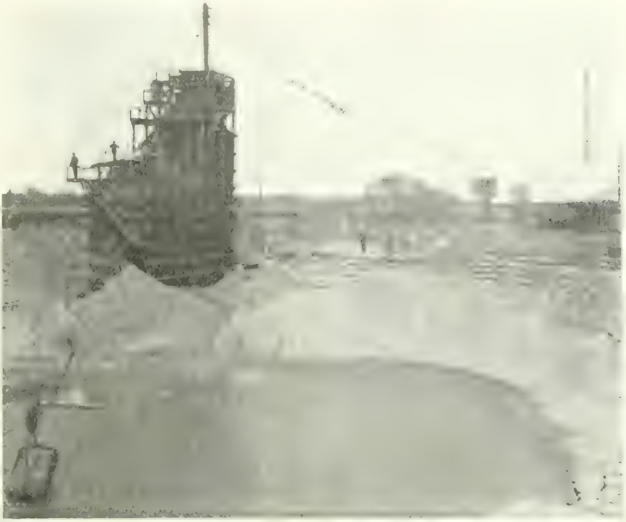


Fig. 7—A Drag-Line Excavator Handling Gravel at a Washing Plant

Loading Devices

The sand and gravel are delivered into cars usually by steel counter-weighted spouts, although some bins are constructed over the track and the sand and gravel are dropped directly down into the cars. In shipping material in this manner there is always danger of over-loading, and one is compelled to rely on railroad weights when shipping. I have lately designed a loading device, equipped with an automatic weigher, which weighs the material as it is loaded.

It consists of a short belt conveyor, mounted on a frame, very similar to a wall crane which travels on the face of the bins, and will stop in front of any gate opening. A section of the belt passes over the weighing apparatus, and the quantity which passes over the machine is weighed. The dial which records the weight reads like a meter, and each car as well as the total amount loaded for the day is recorded. In addition to this advantage, the machine has a swinging loading spout, which spreads the material in the cars, and dispenses with considerable hand shoveling.

In handling material from the bins to the cars, care must be taken as to the grading of the gravel, for while the mixture of material may be perfect in the bins, it may still be separated to a distressing extent when the material is drawn from the bin. The coarse material will flow more readily, and go to the far side of the car or wagon, and the fine material which is more sluggish, will drop into the car on the near side. The result is that one side of the car has coarse material and the other side fine material.

Gravel producers have appointed committees to standardize the grading of material, and in every locality, the production of sand and gravel is demanding interest.

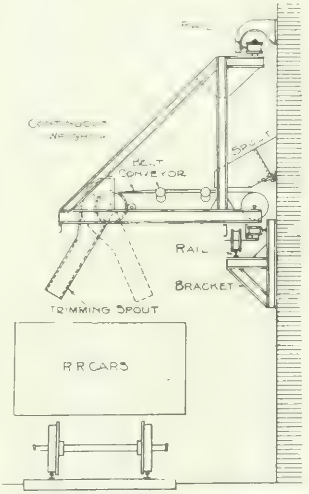


Fig. 8—Detail Showing a Weighing Loader for Handling Sand and Gravel

Action of Electric Currents on Concrete

The Bureau of Standards is undertaking a thorough investigation into the cause and nature of the phenomena observed in concrete under the influence of electric currents, the extent to which damage has occurred or is likely to occur in practice from this cause, and the best methods of mitigating the trouble under practical conditions. The work was begun in the summer of 1910 and certain phases of the investigation are still in progress, but enough work has been completed to justify the publication of a report of progress at this time. The investigation has comprised three general branches, as follows: (1) Laboratory investigations relating to the cause and nature of the phenomena caused by the passage of electric currents through concrete; (2) Investigations in the field with the view of establishing definitely the probable extent of the danger in practice and the circumstances under which trouble is most likely to occur; (3) A study of the various possible means of mitigating trouble from this source, leading to specific recommendations based thereon. This work is under the immediate direction of E. B. Rosa, Burton McCullom and O. S. Peters, of the Bureau of Standards, Washington, and the following paragraphs are a summary of the report on this work read before the Pittsburgh convention of the N. A. C. U. by Mr. McCullom.

(1) The observations of previous investigators that the passage of current from an iron anode into normal concrete caused the destruction of the test specimen by cracking the concrete were only partly confirmed. This effect was found not to occur in most of the specimens tested when the potential gradient was less than about 15 volts over a distance of 3″ or about 60 volts per ft.

(2) Of the numerous theories that have been advanced for the cracking, that one which attributes it to oxidation of the iron anode following electrolytic corrosion has been fully established. The oxides formed occupy 2.2 times as great a volume as the original iron, and the pressure resulting from this increase of volume causes the block to crack open.

(3 Metals which do not ultimately form insoluble products of corrosion and all non-corrodable anodes, never cause cracking of the concrete as a result of the passage of an electric current.

(4) The mechanical pressure developed at the iron anode surface by corrosion of the iron has been measured in a number of cases and has been found to reach values as high as 4,700 lbs. per sq. in., a value more than sufficient to account for the phenomena of cracking that have been observed.

(5) Suggestions of some engineers that copper-clad steel or aluminum be used as reinforcing material have been shown to be impracticable, since the copper coating is readily destroyed and the aluminum is attacked by the alkali in the concrete.

(6) Corrosion of iron anodes in normal concrete is very slight at temperatures below about 50° C.

(7) For any fixed temperature the amount of corrosion for a given number of ampere hours, is independent of the current strength.

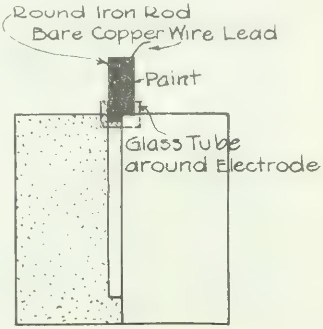


Fig. 1—Type of Specimen Used in Electrolytic Corrosion Tests

(8) The lack of corrosion of the iron at temperatures below 50° C. is due to the inhibiting effect of the $Ca(OH)_2$ in the concrete.

(9) The rapid destruction of anode specimens at high voltages (60 to 100 volts or more) is made possible mainly by the heating effect of the current, which raises the temperature above the limit mentioned above. If the specimen be artificially cooled no appreciable corrosion occurs, and no cracking results.

(10) The potential gradient necessary to produce a temperature rise to 50° C with consequent corrosion, in the specimen used, was about 60 volts per ft. For air-dried concrete it is much higher. This shows that under actual conditions corrosion from stray currents may be expected under special or extreme conditions only, as noted below.

(11) Since the passivity of iron in concrete is due chiefly to the calcium hydrate $Ca(OH)_2$ present it appears probable that in old structures in which the $Ca(OH)_2$ has been largely converted into carbonate will be more susceptible to the effects of electric currents than comparatively new concrete with which the foregoing experiments have been made. The increase in the efficiency of corrosion would however be at least partly offset by the increase in the resistance of the concrete which would accompany the change.

(12) The addition of a small amount of salt (a fraction of 1%) to concrete, (as is frequently done to prevent freezing while setting) has a two-fold effect, viz: it greatly increases the initial conductivity of the concrete, thus allowing more current to flow, and it also destroys the passive condition of the iron at ordinary temperatures, thus multiplying by many hundreds of times the rate of corrosion and consequent deterioration of the concrete. Salt should, therefore, never be used in structures that may be subjected to electrolytic action. Further, reinforced concrete structures built in contact with sea water, or in salt marshes, are very susceptible to electrolytic troubles.

(13) Specimens of normal concrete carying currents increase their resistance a hundred-fold or more in the course of a few weeks. This fact still further lessens danger of trouble.

(14) The rise of resistance is in general due to precipitation of $CaCo_3$ within the pores of the concrete, thus

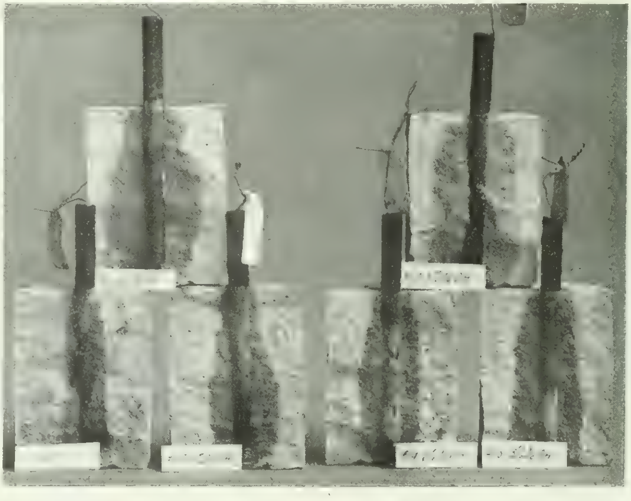


Fig. 2—Specimens Broken to Show the Effects of Various Sodium Solutions in Electrolytic Action

plugging them up. A slight amount of salt prevents this precipitation and consequent rise of resistance, thus still further emphasizing the detrimental effect of salt.

(15) Contrary to the observations of previous investigators there is a distinct softening of the concrete near the cathode. This begins at the cathode surface and slowly spreads outward, in some cases as far as ¼ in. or more. After exposures to the air this softened layer becomes very hard again, but remains brittle and friable.

(16) The softening effect at the cathode noted above causes practically complete destruction of the bond between reinforcing material and the concrete, reducing it to a few per cent of its normal value.

(17) Unlike the anode effect, which becomes serious in normal concrete on comparatively high voltages only, the cathode effect develops at all voltages, the rate being roughly proportional to the voltage in a given specimen.

(18) In general the cathode effect occurs under conditions which may frequently occur in practice and is therefore a more serious matter practically than the anode effect about which so much has been heard.

(19) The softening of the concrete at the cathode is due chiefly to the gradual concentration of Na (Sodium) and K (Potassium) near the cathode by the passage of electric current. In time the alkali becomes so strong as to attack the cement.

(20) Softening at the cathode is increased by increasing the sodium and the potassium content of the cement, and reduced by diminishing this content.

(21) The softening of the concrete has never been observed, except very close to the cathode, the main body of the concrete remaining perfectly sound. Numerous tests show conclusively that the crushing strength of the main body of the concrete is not reduced, even when the potential gradient is maintained at 175 volts per ft. for over a year.

(22) Because of the cathode effect noted above, the method of protecting reinforced concrete buildings by maintaining the reinforcing material as a cathode by a battery or booster would be much more dangerous than no protection at all.

(23) The only effect which an electric current has on unreinforced concrete is to cause a migration of the water-soluble elements. Consequently, in the absence of electrodes, the ultimate effect of current flow on the physical properties of the concrete is not materially different from that of slow water seepage, which also removes the water-soluble elements. Non-reinforced concrete buildings are therefore immune from trouble due to stray earth currents. They might, however, be injured by the grounding of power wires, carried in conduits embedded in the concrete, since these conduits would then act as electrodes.

(24) Conditions do arise in practice which will give rise to damage due to stray currents, but the danger from this source has been greatly overestimated in many quarters. While precautions are necessary under certain conditions, there is no cause for wide-spread alarm.

(25) Waterproofing reinforced concrete would greatly increase its resistance and diminish accordingly the danger from either the anode or the cathode effect.

(26) Waterproofing to prevent electrolysis is, however, a much more difficult matter than waterproofing to maintain a moderate degree of dryness, because of the much higher degree of waterproofing required in the former case.

(27) It has been found that practically all of the waterproofing agents now on the market that are intended to be mixed with the concrete, are of little value as preventives of electrolysis. Waterproofing membranes, etc., applied to the surface can be made much more effective, and when properly applied may have considerable effect in preventing the entry of earth currents into the concrete.

(28) Painting or otherwise coating iron with an alkali-resisting metal preservative before embedding it in concrete may serve to minimize the dangers of electrolysis, but no such coating has been found that does not prevent the formation of the bond between the concrete and the iron when the concrete sets.

(29) In order to insure safety from electrolysis, potential gradients must be kept much lower in structures exposed to the action of salt waters, pickling baths, and all solutions of chlorides, sulphates, nitrates, or carbonates.

(30) All electric power circuits within the building should be kept free from grounds directly on a portion of the building itself. If the power supply comes from a central station the local circuits should be periodically disconnected and tested for grounds and incipient defects in the insulation. In the case of isolated plants ground detectors should be installed and the system kept free from grounds at all times.

(31) All pipe lines entering concrete buildings should, if possible, be provided with insulating joints outside the building. If a pipe line passes through a building and continues beyond, one or more insulating joints should be placed on both sides of the building. If the potential drop around the insulated section is large, say 8 or 10 volts or more, the insulated portion should be shunted by means of a copper cable.

(32) Lead-covered cables entering such buildings should be insulated from the concrete. Wooden or other nonmetallic supports which prevent actual contact between the cable and the concrete will give sufficient insulation for this purpose. Such insulation of the lead-covered cable is desirable for the protection of the cable as well as the building.

(33) The grounding of electric conduits to water pipes and ground plates is in general not to be recommended in the case of concrete structures.

(34) In making a diagnosis of the cause of damage in any particular case, the fact that a fairly large voltage reading may be obtained somewhere about the structure, should not be taken as sufficient evidence that the trouble is due to electrolysis. The distance between the points, and particularly the character of the intervening medium, are of much greater importance than the mere magnitude of the voltage reading. As a precautionary measure, however, all potential readings about a reinforced concrete structure should be kept as low as possible.

Portable Saw Rigs on Construction Work

Centering is the largest single item on concrete work and handling centering economically is essential to low cost building. In the construction of the Larimer Ave. bridge, Pittsburgh, which was opened in July, 1912, a very complete lumber handling equipment was installed. The contractors had a full equipment of wood working machinery in a mill adjacent to the work; in addition to this, they used a portable self-contained saw mill mounted on skids. It was moved from one location to the other, as it was needed.

The Larimer bridge was built alongside of a viaduct already in use, which it has replaced. C. H. McAllister, who was one of the directing staff in the execution of the work, states that the portable plant was of great advantage as it could be readily moved around on the work for fitting floor panels and beams on top of the bridge. The saw was moved along on top of the old bridge. In setting joists, etc., wedges are needed at every point, and the saw mill was especially useful in sawing up scrap into these wedges.

The John S. Metcalf Co., Chicago, has recently completed the drawings for a 1,600,000-bu. reinforced concrete addition to the 1,000,000-bu. plant designed by the same company and built in 1905, for the Atchison, Topeka & Santa Fe Ry. Co., at Argentine, Kan. An office building, carpenter shop and dust packing plant are also included in the permanent improvements, together with such changes in machinery of the present plant, as may be necessary. The total estimated cost of improvements is about $300,000.

Work on the addition is already under way and the Armour Grain Co., now operating the house, hopes to have the use of the new tanks for the next grain crop.

Building a Concrete Residence On Hillside

BY A. MORGAN SMITH*

At the present time concrete seems to be the practical building material for nearly every requirement of building construction; further, it has developed new types of construction which are impossible with other building material. The materials required for making concrete are generally available the country over, and the ease with which concrete can be cast into any conceivable shape right on the job makes it a building material of many advantages. The development of the concrete residence is in the mind of every progressive home builder who demands safe, durable, fireproof construction with the least up-keep cost.

Concrete architecture is a specialty with me. I have found the monolithic concrete residence the most interesting to develop, because in a residence the owner who wishes to exercise individuality either in appearance, utility or durability can very easily have his ideas worked out.

The illustration and floor plans show the concrete residence built for Dr. Herman S. Davis, Pittsburgh, in the summer of 1912. Dr. Davis is a consulting engineer and astronomer, and well qualified to choose the kind of material for his own home.

The building, on a hillside, is well located for convenience in making and placing the concrete. A small power batch mixer was placed about 100 ft. to the rear and 60 ft. above the building site. A permanent chute was built from the mixer down the hill side, and at the lower end a movable trough distributed the concrete where wanted.

The concrete work progressed as follows: Forms for the cellar walls,

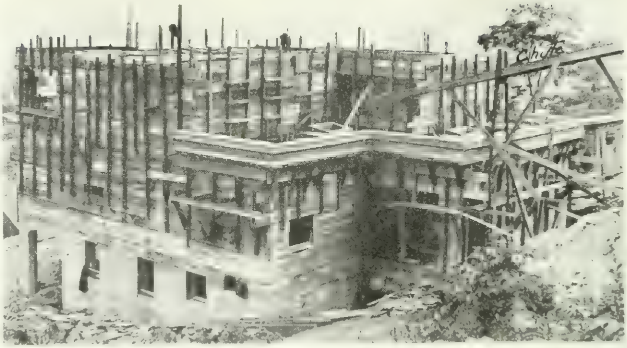


Fig. 1—A Concrete Residence Nearing Completion

This view shows the wall centering in detail, and the home-made chute coming down the hillside from the right. Note how the sheathing boards are not cut at the corners but extend beyond. The rear window of the bedroom, shown in the center of the view, illustrates the difficulty of always getting the concrete to flow under window frames when running walls. The surface of the walls shown here, which so far are untreated, indicates careful grading of materials and spading

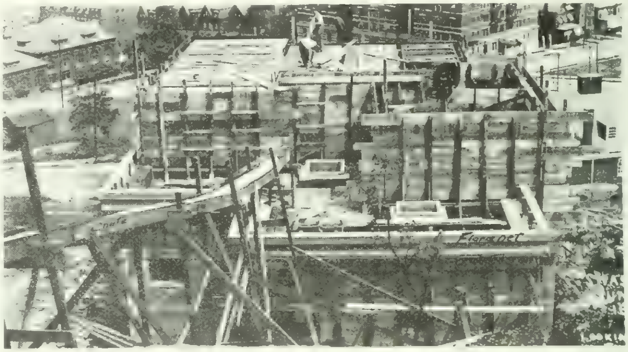
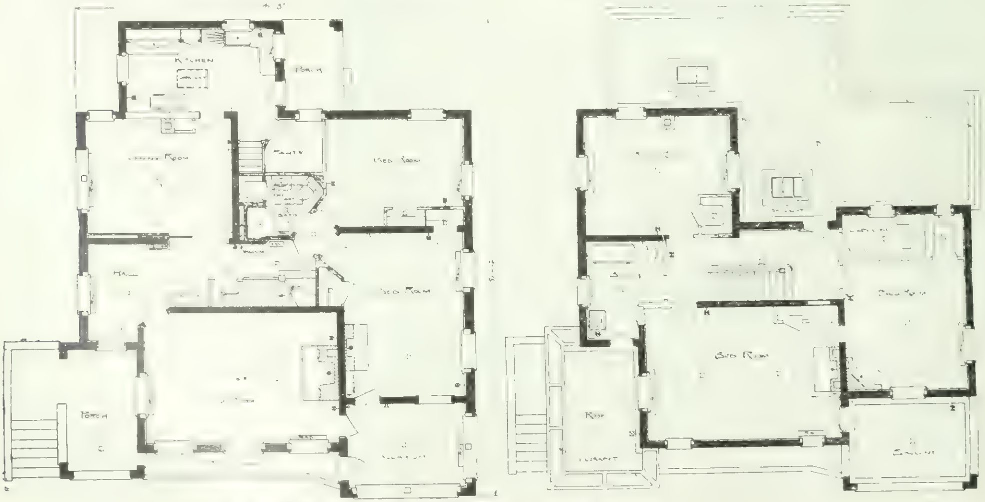


Fig. 2—Placing the Centering for the Roof

In the extreme right hand corner, the joists are placed, and the sheathing is being set over the central rooms. The concrete chute comes down from the left in this view. The sheathing extending beyond the corners is shown at the right



F[illegible]—First and Second Floor Plans of a Concrete Residence in Pittsburgh partitions and floor slab for first floor were built and the concrete poured. Then the second story followed in like manner and so on till completed. Openings were left in the floor slabs and the walls for piping, wiring, etc. The window and door frames were all set in the forms.

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*Arch., Mt. Lebanon, Pa.

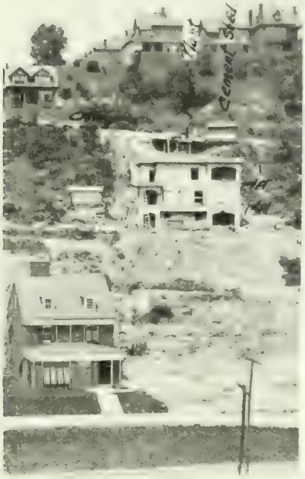


Fig. 4—General View Showing the Location of the Davis Residence

The alley at the rear and the position of the mixer plant at the rear are shown.

The roof is of reinforced concrete with a slope of ¼" to the foot, draining into 2-in. brass pipe conductors. There is no flashing on the roof except around the vent pipes, which means a roof that really improves with age. No waterproofing compound was used.

The three-section laundry tubs and shower receptor are cast concrete. In the cellar a concrete rain-water tank of about 150-gals. capacity supplies water by gravity to the laundry tray.

The beams are reinforced with rods and the floor slabs, figured to carry a 75-lb. live load are reinforced with woven wire. The inner side of the outer walls are furred, allowing a 1-in. dead air space; and the floor slabs are overlaid with wool sleepers to which the finished floor is nailed. The space between the floor and the concrete slab is convenient for wiring and pipes. For the walls and partitions a 1:3:6 mix was used; for beams and slabs a 1:2:4 mix.

With the flat roof construction the skylight makes many new features possible. In this residence the bath room on the first floor has no outside walls for windows; the skylight lets in a flood of light and ventilation is easy to regulate. The skylight over the kitchen offers many advantages, and the one over the second floor hall lights up that part of the house, which in most houses is dark and dreary in the day time.

The guard around the front porch roof is called a "florapet," that is, it is troughed out for filling with earth and planting flowers. From this has originated the name "florapet."

This winter, when the outside temperature was zero, the inside rooms were 70° with a boiler temperature of 140°.

Contemplated additions to the plant of the Atlantic & Gulf Portland Cement Co., Ragland, Ala., are planned, increasing the daily capacity of the plant to 2,000 bbls. The improvements will cost about $50,000.

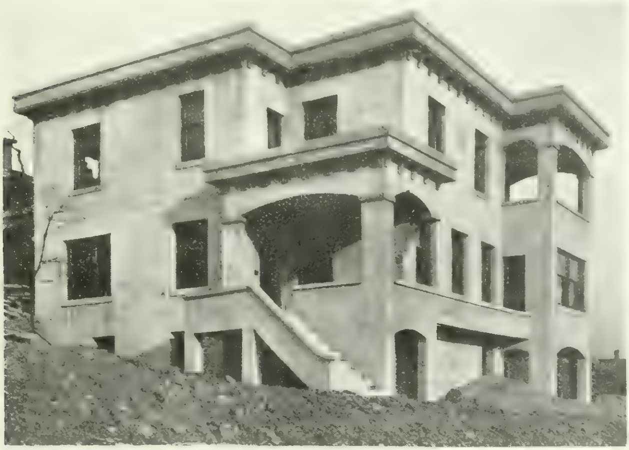
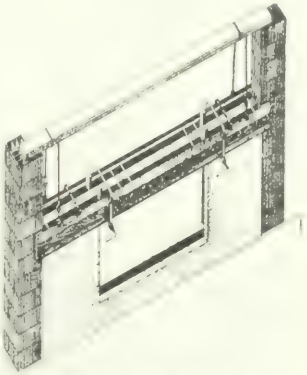


Fig. 5—The Finished Concrete Residence

Note the simple cornice detail used

Double Concrete Walls with Tile Columns

In building fireproof houses at Richmond Hills, L. I., or Kew Gardens, as it is called, Gurden S. Mumford, a New York architect, has developed and used a system of wall construction presenting several new and unusual features. Hollow tile are used to build wall columns; these are reinforced with concrete and steel, and between the columns is cast a double concrete wall. In this system, hollow tile are used in a most economical form as isolated columns, in through-bonding and in partitions, where strength, lightness and temperature insulating qualities are required. The floor and wall weights are carried mainly by the reinforced tile columns, transmitting the load to them by means of reinforced girders.



[illegible] Isometric View Showing the Arrangement of [illegible] Wall Forms and [illegible] Columns

These concrete and tile columns are tied together with wall girders at the floor line, and at the roof plate, which in turn carry the floor construction.

The "Unit" Form: The form used consists of two planks 2" wide, 14" deep, and 16' long, with a 3-in. slightly tapered plank of the same depth, in three sections of about 5 ft. each, placed between these outside pieces and used as a core to make the hollow wall. At each end, are short wedge-shaped pieces. Each section of the 3-in. plank or core mold is held in position by angle irons which rest on the top of the two outer planks and abut against an iron plate secured to the outside pieces. The whole is so arranged as to be securely clamped together top and bottom. A turnbuckle clamp at either end unifies the two outer planks and permits a positive movement outward when necessary. At each end of the two outside planks an iron strap or casting is fastened to the iron plate already mentioned, which allows a rope to be passed from them to the planks overhead, for support if it is desirable for the form to stay in place for any time. A simple tackle permits the whole form to be raised with a minimum of effort and friction.

Operation and Construction: Tile piers 10" square are built every 16' on the wall lines of the building to a height of 12', and ⅓ or more of the cells in the tile are filled with concrete reinforced with steel rods. This gives a number of permanent supports. On top of these, two 2-in. x 8-in. planks are stretched and to these, by the block and tackle arrangement, the unit form is attached. As the form consists of 2-in. x 14-in. planks an allowance for a 2-in. lap gives 12" for the effective height of the form. The concrete is poured in and tamped in the usual manner, preferably a semi-dry mix. The number of forms used is such that by the time all the forms have been filled the concrete in the first form will have set—the clamps in the first form are loosened, the wedge core pieces removed and the form as a whole raised 12" by the tackle already described; the clamps are then re-set and the operation repeated.

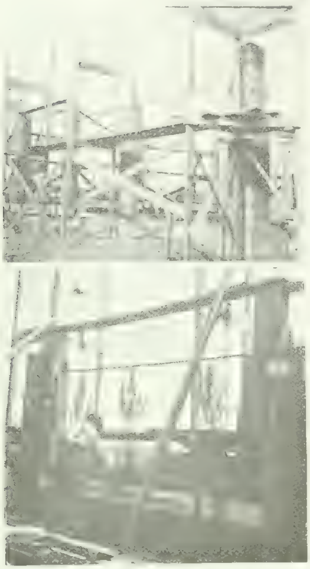


Fig. 2—Above, Are Shown the Tile Columns Erected; Below, the Form in Use on the Wall

At the level of the caps of the first story windows a solid concrete girder the full width of both inside and outside walls, is made by removing the 5-ft. intermediate tapered pieces. Rods previously built into the column at the proper height form the reinforcement for the tension member of these girders and securely anchor them to the tile piers. The hollow wall is then continued to the second floor level, and the structural part of the second floor erected. The tile columns are then continued to their full height, and the roof plate securely anchored to them. The unit form is then hung from the plate just as it is hung from the 2 x 8's., and the process continued. The wall immediately below the roof plate consists of 10-in. tile filled with concrete and reinforcing rods, as it would not be practicable to build this with concrete on account of the wall plate which is already in place. At such points as may seem desirable, the double wall is tied together by flat tile inserted in a special core mold.

This construction apparently makes for economy of material, as the two walls are merely thin curtain walls. On the other hand, the frequent tying together of these two walls by the non-conducting tile lintels, jambs, etc., at the openings, obviates the necessity of through ties and divides the concrete double wall into panels, preventing any tendency to crack.

It may be noted in passing, that this method is peculiarly favorable to the exposed-aggregate treatment, as the outside wall, carrying no weight whatever, is thin, and can economically be made of marble chips or other specially selected aggregate. The construction used exposes the wall to the air very speedily, so that a weak solution of muriatic acid and water and a scrubbing brush *plus* an active laborer, are all that is necessary for an artistic finish.

The system described offers several unique and apparently practical features. Suspending a form from riders carried on pre-erected columns is a development which seems to promise much. The system as a whole and the various forms have been patented by Mr. Mumford.

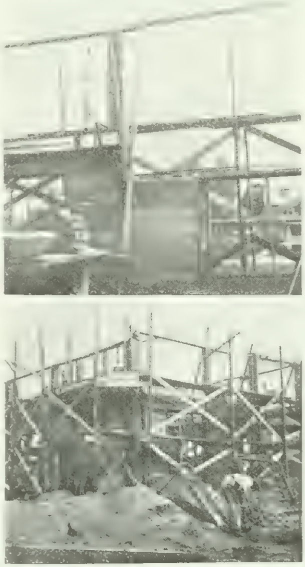


Fig. 3—A Detail View of Interior of the Wall Under Construction is Shown Above; Below an Exterior View of the Walls Nearing Completion

Note in the upper view that tile of different section are used, to provide a seat for the lintel beam. The reinforcing steel is hooked and dropped into the projecting tile.

The view below shows the form in use. The block and tackle is carried back to a drum shown in the lower left hand corner.

An Industrial Village on Garden Lines

Ballinger & Perrot, architects, Philadelphia, have issued an attractive brochure describing an industrial village on garden lines, which they are building for the American Viscose Co. at Marcus Hook, Pa. Large enterprises of an industrial nature are confronted with the problem of securing an adequate force of operatives and housing them under proper conditions in the immediate vicinity of the plant.

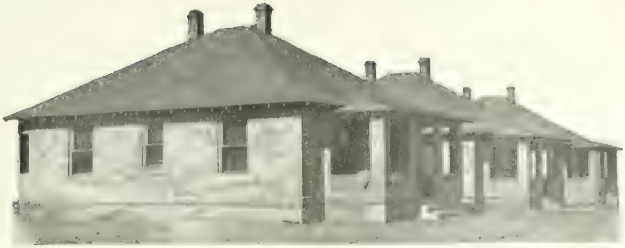
The problem, in part, is being solved for the company by the architects through the construction of a "model village," occupying about 20 acres, directly opposite the plant and separated from it by the main thoroughfare between Chester, Pa., and Wilmington, Del. The general idea of the village is based upon studies of similar communities in England, Germany and the United States, but a number of unusual features are embodied in the Ballinger & Perrot plans.

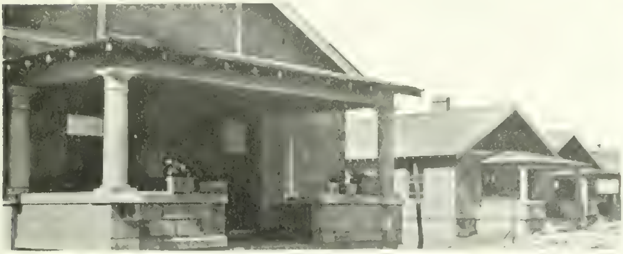
The focal point of the plan is a generous semi-circular tract, bounded by a street from which issue the three principal streets, running north and south. In the semi-circular tract will be a large building which will be given over to social purposes; here will be located a large auditorium, library, gymnasium for girls, one for boys, and so on.

Fronting on the focal point will be the best grade of houses in the village and on other streets houses will be located in groups of from two to fourteen. A total of 261 private houses, besides two boarding houses, is called for in the plans.

Broadly speaking, the village houses are divided into two groups. Those of the smaller type contain stair hall, living-room with old-fashioned fire place, dining room and kitchen on the ground floor, with three bedrooms and a bath room, with toilet, on the second floor. The larger houses have four rooms and bath on the second floor. All houses have been planned to be wide and shallow, so that all rooms are directly lighted either from front or back. They are furnished with basement and heated by furnace. Low iron fences separate the back yards and hedges the front yards. Red brick walls are to be utilized, with slate roofs in construction. Streets are of macadam.

The Fowler & Pay cement works, near Austin, Minn,. was destroyed by fire Feb. 7. Damage is estimated at $50,000.





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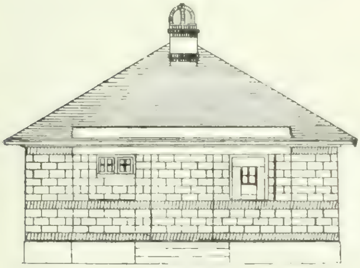
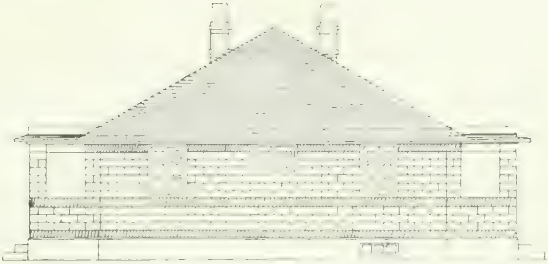
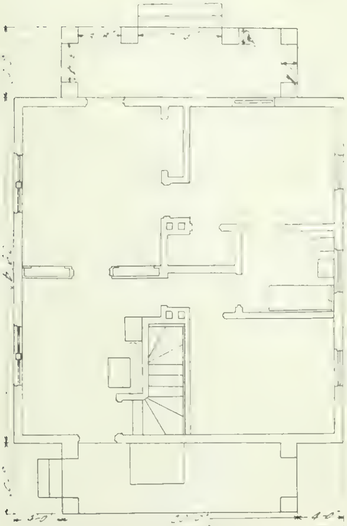
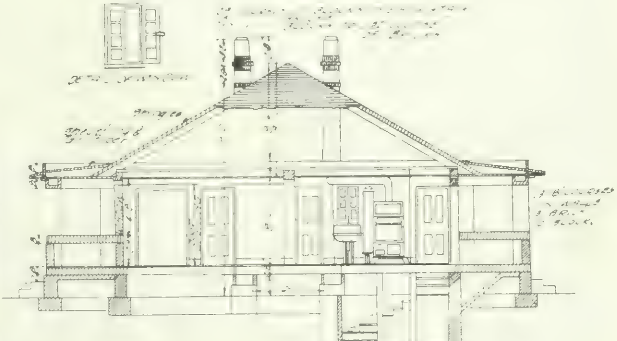
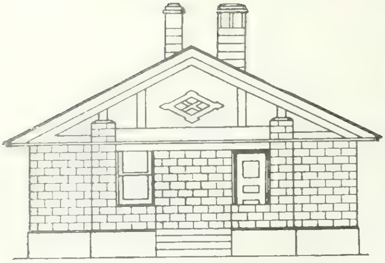










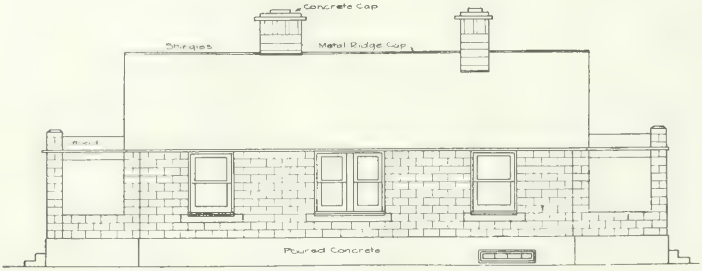
FURTHER DETAILS OF $1,500 CONCRETE BLOCK COTTAGES—ALSO SEE PREVIOUS PAGE

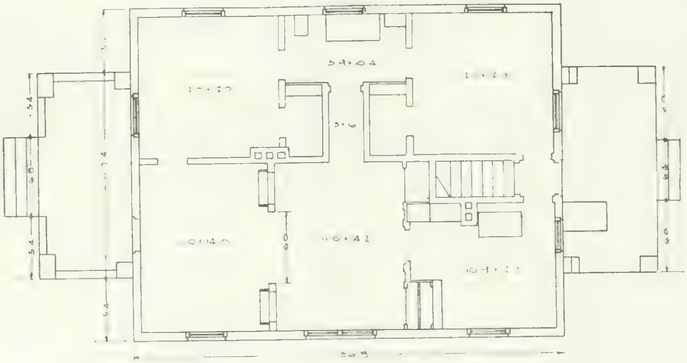
FRONT ELEVATION

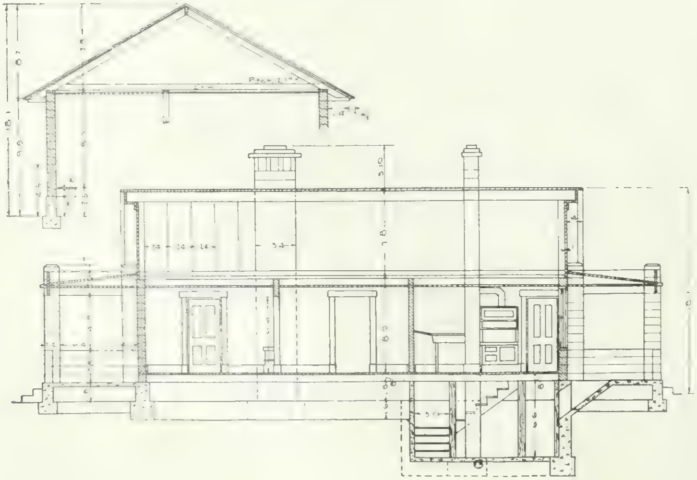
SIDE ELEVATION

PLAN

SECTION







Concrete Block Cottages Built Complete for $1500 Each

The accompanying detailed drawings show two types of concrete block cottages built by the U. S. Portland Cement Co., Denver, for workmen. Twelve houses were built at a contract price of $18,000, and out of this amount, which was paid to the contractor, the contractor paid the cement company 10 cts. per block for the block used in the construction. The block were made in a plant at the factory of the U. S. Portland Cement Co. using an Ideal[1] block machine with Kramer[2] tamper. The back of the block is a mixture of 1:5 and the face ½" thick of a 1:3 mix.

The interior walls of the cottages were plastered directly on the block and this has been very satisfactory. To avoid any moisture at the joints all the block were laid with a gauge. The houses are finished inside in natural wood with Texas quarter-sawed flooring, electric light fixtures, two in the dining room and two in the living room and one in each of the other rooms, these being included in the contract price together with bronze hardware throughout the house, a steel range with water tank connected, nickel-plated open plumbing and porcelain bath room equipment. Porches of the houses have concrete floors and the rear porches are screened in. Porch columns on some of the houses are of concrete block and in the larger houses the columns are of poured concrete. Most of the essential details of construction are shown in the drawings.

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[1] Ideal Cement Machy. Co., South Bend, Ind.

[2] Kramer Automatic Tamper Co., Peoria, Ill.

Concrete Block—A Symposium

Editorial Note.—It is our purpose to open up so far [illegible] possible the [illegible] of "The Concrete Block." The concrete block is a better building unit than it used to be but some architects find it not yet quite good enough. Is this *prejudice* or is it ripe judgment, after careful investigation? Architects agree almost unanimously as to the potential possibilities of concrete block in sound building and in architectural effects. An article by Charles W. Doubler on "Realistic Stone Facings" in the December issue brought Oswald C. Hering's letter criticising "rock-face" and "dry-process" block. This was published in Feb. Correspondence department and elsewhere in the same issue a further discussion, by Mr. Hering, of concrete block in residence construction was published. On this and following pages appear more letters, presenting different views. Architects are particularly invited to let their views be known through these columns. The architect cannot ignore concrete building units; he should do his part to show that concrete building units already are found to be satisfactory or he should tell how these units may be made satisfactory.

BY M. WETZSTEIN*

In reply to this question, I would say that I am satisfied in some cases, and then again, I am not satisfied in others. The concrete block has more or less suffered from prejudice. The prejudice was developed naturally, because of the fact that in the beginning the poorest kind of concrete block were made. I am not an old man, but I well remember that I have seen the poorest possible quality of clay bricks made, bricks that would crumble in the hand, or rapidly scale and disintegrate when placed in the wall. These bricks were the pioneer bricks, just the same as in the beginning the poorly made concrete block were the pioneer block, and the fellow who made these block was in reality the man who blazed the way for the better block, which is becoming daily more in evidence.

Concrete block have been made but a few short years, and it was only natural that a product, so easily made, should appeal to the cupidity of the general run of people who like to dabble in anything from which they believe they can make some easy money. Machines with which to make concrete block could be bought at low prices; the ingredients easy to obtain; cement at reasonable prices, with the opportunity of buying the latter in small quantities and in consequence, the capital invested was so small, and the making of the concrete block so easy, that every Tom, Dick and Harry saw an opportunity of becoming rich.

The demand for concrete block became unusually brisk; in fact, the demand was far greater than the supply, and in consequence, the concrete block putterer, having his money-making instincts aroused, made block with greater rapidity, thus not tamping them properly, used less cement, was not particular as to the proper mixing of his gravel and cement, made the block dry instead of wet, so it could be more easily handled, sold them before they were half cured, and naturally, the building block as a building material soon secured for itself a poor reputation.

The artistic possibilities of the design and facing were entirely lost sight of. The imitation rock face—horrible even to this day—was the prevailing design, but with all these handicaps, the unprejudiced builder, contractor, and every architect, knew that a concrete block, if made of proper concrete, would and should be just as good as the concrete used in sidewalk construction, or for that matter, for any other purpose. They realized that a well-made concrete block was a good unit, and as such, a unit could be inspected, tested, and had unusual points in its favor in the ease with which it could be handled, etc.

It is therefore a fact today that with proper concrete block-making machinery, with proper mixing, with the correct amount of water used in mixing, with power tamping, with facing possibilities, with beautiful designs, with steam curing, and the product one of great strength and artistic beauty, the concrete block appeals to the business man. It is, therefore, the business man who is now getting into the traces and producing block in a business way, and they are being extensively used throughout the country.

There is no end of room for improvement, but where formerly the little fellow without capital did the pioneering, today companies are being formed with large capital, which are producing the best of products only. The industry is young, yet the strides made are wonderful. Architects are just as unreasonable as are other people, consequently, because they may have been "stung" early in the game, they continue their condemnation. They are not keeping abreast of the times and are blind to what is going on about them; nor should they be blamed too much, as it is true that plenty of poor block are being made, yet those made in perfect manner today, far exceed in production the poor ones.

It is impossible to bring perfection into an industry in the short space of 10 years. Why don't the architects recognize this? We know of block turned out in extensive concrete block products plants, every one of which is of absolute perfection. It is true that such plants may be more or less far apart at the present time, but just as sure as the sun shines, the gaps will be closed, and within another 10 years, the concrete block will be manufactured in absolute perfection in every large center in this country.

If an architect knows that he can secure a dependable block, and his client desires to construct of concrete block, and the architect advises against their use, then it must plainly be a case of prejudice, and a shutting of the eyes to that which he does not desire to see.

The equipment manufacturer has, in many cases, arisen to the needs of the block manufacturer. It is, therefore, up to the block manufacturer to adopt high-grade, power-driven machinery. After installing the machinery, it is up to the block maker to secure high-grade materials, to grade and mix them properly, and thus place upon the market a dependable block. When he does this, and the architect will not specify such block, then the architect is prejudiced. There is but one way to remove that prejudice, and that is, to have the architect visit such block-producing plants, to note the material used, its grading, its mixing, and the manner in which the block is power-tamped. Then he should be shown the steam curing chambers and the proof that the block are properly cured. He should then be allowed to select one, two or more block, and have these block undergo the proper tests prescribed for their use as a building material, and in this way he will be convinced and his prejudice removed. As the architect, in the writer's opinion, actually controls, through specification, at least 70% or more of the material used in building, it must naturally stand to reason that he must be the one to specify concrete block and concrete architectural stone to make those products the wonderful success their use will bring.

Among the writer's customers, he calls to mind two construction engineers of Italy who, in the purchase of machinery, made their own concrete block and concrete stone, made them in positive perfection, and have succeeded in displacing, almost throughout Italy, all other kinds of building material, and have wrought artistic results.[1] These men of Italy knew their business, recognized the concrete block, and by proving to the Italian architects, contractors, and builders that they were making a block of perfection, a block of beauty, a block artistic, they found it an easy matter to have them adopted, and the great work they have accomplished in the last four years speaks for itself.

The entire blame does not rest upon the architect. It lies equally with the concrete block manufacturer. Convince the architect, and he will lose his prejudice.

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*President Ideal Concrete Machinery Co., South Bend, Ind.

[1] Views of some of these buildings in Italy are shown elsewhere in this issue

BY OSWALD C. HERING*

I was very much pleased to find in the current issue (February) of Concrete-Cement Age so liberal an amount of space given to the presentation of the merits and defects of the concrete block, and I was particularly glad to read your editorial inviting architects to voice their opinions of its present status and to suggest a way for its architectural development. It is their duty to respond to your courteous invitation, for it is partly the architect's fault that the concrete block has not acquired the dignity of brick and stone as a building unit. He has not given it the study and attention that it deserves. An architect is also an educator and it is his duty to investigate every form of building material and equipment that will add to the comfort and happiness of life within the structure he designs, and inspire those on the outside with loftier ideals.

I congratulate Concrete-Cement Age on its courageous and open-minded attitude and I venture to predict that from the ruins of the rock-face, dry process block factory, there will spring up a huge industry of concrete block, durable, beautiful and acceptable for any kind of articulated design that in the past has demanded an expression in stone. It pays to be honest, even in the manufacture of building units.

BY W. L. ROHRER†

I agree with Mr. Hering that the average concrete block manufacturer does not use enough water in the process of mixing. I suppose that 99 out of every 100 use too little water. We can never put the concrete block to the front as long as we use the so-called semi-wet mix—that is to say, the blocks get one half enough water in process of making, and the result is a spongy, porous, weak block.

What is the cause? First, it is the way the block makers were taught. Second, because few block men know that a wet block can be made on their present machines. They think the block will sag or the facing stick. The block will sag if it is made *sloppy* wet, but on a machine with five or six small cores instead of two large ones, a much wetter block can be made without sagging.

As for the facing sticking to the face plates, this can be overcome by making the facing material just wet enough so it will not stick to the plates. Then make the block as quickly as possible so the water does not come through the facing and cause it to stick to the plate, and 10 minutes after it is made the excess water in the body of the block will come through and give the facing quite a lot of water. If granite crystals are used it is a good practise to wet the green block with a very fine spray of water, which not only brings out the granite in all its beauty, but at the same time gives it all the water it will take, making a very dense face. This can be done without additional expense of more than ½c per block. This is less expensive than Mr. Hering's suggested method of scrubbing the block to get the thin coat of cement from the face.

Another point I would like to bring out is the making of a block 8"x16". A building made of block 8"x16" puts one in mind of a child building a toy house out of his ABC blocks, or a large checker board—they are not rightly proportioned, are too high for their length. Let them be made 6"x20", that is 6" high, 20" long and 8" wide. One man can lay them to better advantage than he can block 8"x16" or 8"x24". One man can make them, when it takes two men to make a block 8"x24".

BY A. T. BRADLEY*

I must state that I am not satisfied with the present achievements in the manufacture of concrete blocks, and I believe that the cause for the antagonistic position taken by the average architect is merely in the fact that so many inferior block have been made, by a great many of the smaller block makers especially, their main point seeming to be the question of profit rather than quality. When they buy a machine, the matter of price is in many cases apparently more important than quality, consequently it is not surprising that in the past the manufacturer of the cheap machine has enjoyed the greatest sales.

These machines, being entirely too limited to allow for producing the size required by the average architect, it is impossible for the block manufacturer to meet the requirements of the architect, with the result that the architect becomes disgusted and refuses to specify the product in further contracts. This is borne out in a communication received by us from an architect, who has been specifying concrete block very firmly the last few years for church construction. After complaining as regards a block maker using an 8" high block for a large church, he writes us as follows:

"I am determined to use the 10" block there and everywhere else. Machines which simply allow for the making of one size of block as to height will not produce good architecture."

This block maker referred to, owning one of the small machines, could not see the advantage of installing a high priced equipment, that would enable him to meet this architect's requirements, and as a result he begins to discourage the architect by claiming his inability to produce the size required and endeavoring to go back of the architect and get the owner's consent to use such block as he makes.

My only object in bringing this up is to show one reason why architects become discouraged in specifying block. There are machines being offered that will meet the requirements of the architect, but they are more expensive than the small, one-block equipment and consequently the stone makers, thinking of the cost of the machine, decide on a cheaper equipment.

It is gratifying to know that in many of the larger cities, larger companies are being formed for the manufacture of concrete block and other concrete products. These companies are bringing their products to the attention of the architect and offering to deliver him a finished product such as he requires, and, as these large companies or plants increase in number, we believe that the block will take a better stand. We think, therefore, to sum up, that the main trouble lies with the block maker.

BY CHARLES H' DOUBLER*

That the first attempt at producing concrete units was a "Jonah"—a boomerang as it were—to the industry, goes without question and especially were the "rock-face" imitations of pitched stone, all of one size and all made from one cast iron face-plate of impossible stone texture, things to be abhorred. No one with a spark of aesthetic sentiment in his make-up could countenance their use or blame architects for condemning them. They were justified in declaring, as they did, that to produce such riff-raff in imitation of cut stone was a libel on art and a wrong that no self-respecting architect could advocate. Some architects, wishing to be heard and known, even went so far as to declare the production of such units a crime, a fraud, a sham; an unpardonable sin—and all the rest.

The criticism[1] by Oswald C. Hering,[2] of the article "How to Produce Realistic Stone Facings," sounds like—or is it the echo of—the old "broadside." But the shots fall flattened. They fail to penetrate. The reproduced stone described in that article is no more like the old "abominable unit" than we are like the ancestors which Darwin assigns to us.

I recognize Mr. Hering as a co-advocate of a higher concrete standard, we have much in common, and, while I consider him unduly zealous in advocating what appears to me to be an over-emphasized point in aesthetics, I concede him the same right to his convictions which I demand.

To those who read the article "How to Produce Realistic Stone Facings," it must have been evident that the writer *does not* advocate imitations, as the criticism avers. Neither is this reply to be taken as a defense of such imitations, nor of shams of *any* kind. It *does*, however, defend the claim that concrete units made as described in that article—units honestly made of honest materials, the exposed faces made of natural colored aggregates (in which no sham can exist) and the surface cement removed to expose these colored aggregates to view, these units to be molded on composition face-plates made direct from cut stone, in sufficient diversity to relieve any tendency toward monotony—are better units, handsomer units and better adapted to artistic architecture than natural stone, as they can be made to conform in harmony with any color scheme desired. Furthermore, such units can be legitimately used in any spot or place and in any style where natural stone can be used, and with no excuses, for they are improvements over stone and *not an imitation*.

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*Madison, Wisc.

[1] Feb. issue, Correspondence Dept.

[2] Dec., 1912, issue, p. 55

The gist of this "tempest in a tea pot" centers around the term "imitation," or its application. Literally it means a copy, but if we accept it in that sense we are all imitations and imitators. By common acceptance the term is one of derision, slightingly used to designate an inferior effort, or thing, made to resemble a superior one. If, however, the "imitation" surpasses the original, it is no longer an imitation, but an "improvement." Natural physical conditions produce ice; man by his ingenuity also produces ice—real ice, better, too, than the natural product—but we do not call it imitation ice. Natural physical conditions have produced stone. *Stone is concreted mineral matter. Man, by scientific methods, selects such mineral matter as produces the best results and concretes them into stone, real stone, not an imitation, but a better stone for the purpose than Dame Nature ever concreted in the ground.* We call such productions "artificial," not by way of apology, but to designate them as "made by the art of man."

If now, through science we are able to produce a better stone and by skillful work and good judgment in choosing our aggregates, a more beautiful stone than the natural product, is there any sane reason under heaven why we may not use it precisely as stone, or why we should confine its use to narrow channels, distinctively concrete?

Is it not a libel on human intelligence to assume that we must refrain from making it into units that look like or resemble natural stone for fear we may cruelly wrong, by deception, some overripe aesthete who may some day discover that some dignified structure, which he had heretofore fairly worshiped as divinely beautiful, was not built of natural stone as he had supposed, but of concrete stone made by vulgar man?

Away with such superciliously superficial aesthetics! They are a greater sham and do more harm to a deserving industry than the rottenest concrete block ever laid in a wall! The poor block proclaims its worthlessness to all beholders while the sham aesthetes, hiding behind a cloak of ultra-respectability, have a more or less prejudicial influence with those fastideous individuals who estimate quality and worth solely by the cost.

The criticism is somewhat bombastic and altogether ambiguous. In one breath *all* concrete units are condemned to perdition and the intimation given that it *is* possible to make a satisfactory concrete unit. Perhaps these ambiguities are made clear in Mr. Hering's "recently published volume." One is left to gues if all types of cut stone reproductions are taboo, or if the battle-cry is raised solely against the "rock-face" reproduction. If the latter, then why? Why make fish of one and flesh of the others if we are going to split hairs?

Perhaps it is the reproduction of hand work by molding that is so objectionable. If so, and this *is* a wrong, a deceit, why do sculptors first mold their statues in clay and then cast the "real thing" in bronze instead of cutting them from the solid alloy? Obviously for the same reason—the same sensible reason—that we mold concrete units, i.e. to save cost of labor and materials. Isn't this "straining at a gnat" regarding such minor things as building units and "swallowing a camel" in high art?

It would also be refreshing to know (if such a standard of aesthetics *is* to obtain) why "reputable architects" specify for dignified buildings such glaring frauds, such hollow shams as a mere shell of baked clay, molded in rank imitation of massive cut stone of the most expensive styles? Surely this must be excrutiating to their sensitive natures, or, do the "Clay Interests" apply their balm so copiously as to assuage the otherwise mortal pangs of their aesthetic souls?

The contention that it is the stonecutter's hand and not nature that is responsible for the difference in the texture between one pitched stone and its neighbor is trivial, irrelevant and as ridiculously absurd as the point of aesthetics. Any one who has ever even *seen* a stone pitched must know that aside from directing the blow deep or shallow, following the "scribe" and applying the force, the stone-cutter has absolutely nothing to do with the texture of a pitched face. In fact, it is the only form of cut stone that presents a "natural" face—a face not marred by tools, for no tool ever touches the face of a well pitched stone. Nature supplies the "grain," and the applied force, following the lines of least resistance, breaks the stone where Nature wills and no stone cutter, however skilled, can pitch two alike.

To the question "does he not know that dense concrete is waterproof" the answer is NO! After years of research and experimental work in various kinds of artificial stone, I have never yet been able to produce a single untreated specimen that would not take moisture, even when made under pressure so intense as to crush a wooden pallet to pulp. Neither do I believe it a physical possibility to produce such concrete under any conditions. True, we can make concrete much more nearly waterproof than either stone or un-vitrified brick and enough so for almost any purpose, but that is not the point at issue. Moisture taken up by either stone or concrete turns the color to a darker shade while it is present. To obviate this we must exclude the moisture and this can be done only by filling the minute voids with a solid or by vitrifying. If transparent, colorless waterproofing is used as directed, it fills the voids with a mineral substance which solidifies, thus preventing the moisture from affecting the color by excluding it and the wall will have practically the same look in wet or dry weather. This waterproofing penetrates the facing to a considerable depth, solidifies and becomes a part of it. It is *not*, therefore, a veneer as the criticism erroneously avers, nor is it used to cover a "confessedly poor concrete."

Is it not a mistake to condemn a unit one never has seen? Does not one assume considerable responsibility in acting as the mouth-piece of others by declaring unequivocally that "no reputable architect will advocate the use of this block? Is this statement true? One can be cited, who still has sufficient reputation that his services are in demand throughout the U. S. and Canada, who, after a careful inspection of the units under discussion, frankly stated that *at the same price* he would specify and prefer them to cut granite—and there are others, all "reputable," of the same opinion.

It is indeed strange that any one should construe "How to Produce Realistic Stone Facings" as an effort to promote a concrete unit with the view of deception. The fact is it was intended to demonstrate a simple method of producing a concrete unit so infinitely superior in *every* way, physically and artistically, to natural stone that the maker would be so proud of his production that he would be truly insulted, hurt, if any were to infer that it was common old natural stone dug from the bowels of Mother Earth! He would even like, if decency would admit of it, to placard his structure "Made of Concrete by Jones"—want to *deceive* any one? Not he.

The "will not know or care" sentence means that the public in viewing structures built of these units, rightly made, will see artistic effects in color and sparkling life so much more attractive than anything it had heretofore seen—effects that natural stone cannot rival—that the minor consideration as to by whom, or how the units were made would never be raised. It would neither "know, or *care*," whether nature or man was the producer and if some simpering, sham aesthete were sneeringly to volunteer the information that "it was nothing but concrete," it would intelligently reply—"Well, maybe it is; if so, it is concrete for mine in the future!"

Pardon the smile that the reference to the "corpse, coffin and boneyard" in the criticism, calls forth. It strongly reminds one of a recent forceful article by Peter Finley Dunne, in which Mr. Dooley remarks that "niver agin" can he be induced to "attind *another* funeral of William Jinnings Bryan." Likewise any one who presumes to think that he has the concrete block industry, or any portion of it, nailed in its coffin and is sitting on the lid has "another think coming!" It has been buried regularly at least three times a year for the last decade, but, like truth crushed to earth, it rises again. That the "corpse" lives is attested by the thousands of plants scattered over the country and it is safe to say that 75% of the collective product of these plants are of the "rock-face" type—"the abominable unit"—and 75% of the remainder are of some other form of cut stone. This clearly shows the popularity of cut stone effects in concrete units with the public.

That the majority of these units are of the "imitation" class and not what they should be from an artistic standpoint is to be lamented by those who have the real interest of concrete at heart. To better this condition should be our aim. We cannot expect to wipe out this type of unit, nor is it necessary, or even desirable to do so, as that would narrow and limit the uses of concrete. We can, however, by a little care and judgment, make it the most attractive, as well as the best, building unit.

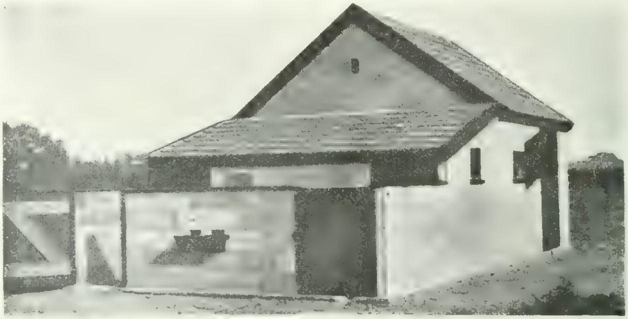
Neither can we expect to force the owners of these plants to "scrap" their present equipments without further notice, as the criticism suggests, and adopt our ideals of unit construction, for, in many instances, these equipments represent their owners all. We, who look forward to better things in concrete, must admit that some of the block machines do not come up to the requirements of an ideal concrete industry, such as it is hoped the industry will soon become, for their product is too stereotyped at present to meet the demands of true aesthetic principles. We all have our pet ideas as to the construction of the perfect unit, but time is required to work these changes, it cannot be accomplished "instanter." We can, however, lead the industry, step by step, to a higher plane. If the public demands cut stone effects, let us make them as they should be made. If one plant in each city or village adopts the methods advocated in "How to Produce Realistic Stone Facings," making just as many different sized plates, and from different stones as it can possibly afford, use natural colored aggregates and treat the block as therein described, it will be but a short time until every other plant will be obliged to fall in line or close its doors.

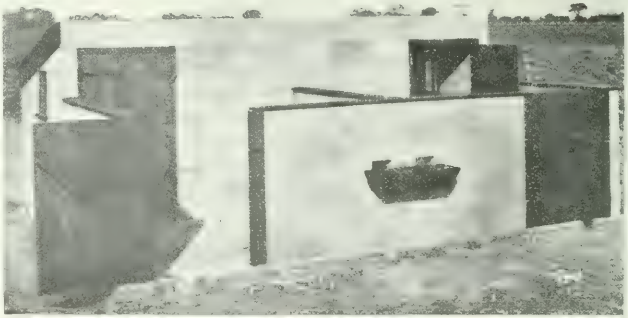
In this manner the old "abominable unit" will be driven from the market or confined to cheap buildings. The industry will thus be placed on a more dignified basis and in line for further advancement. Is this not a better plan than to try to kill such a giant with a pea-shooter?

There is no doubting the fact that this is the day of advancements in concrete unit production. The public demands it, the architect demands it, the financial interest of the producer demands it, the eternal fitness of things demands it and 1913 will witness greater strides in that direction than any previous year. "Advance" is the watchword of the hour! Let each of us put his shoulder to the wheel and all boost together, doing away with petty sentimentalities, for stone *is stone* whether made by Smith, Jones, Brown or Nature! Let praise—and patronage—be the portion of him who excels!

Concrete Block Farm Buildings Built Economically in England

The illustrations, published through the courtesy of *Concrete and Constructional Engineering*, London, England, show some farm buildings erected entirely of concrete and concrete block on the estate of Wayford Tenants, Ltd., Norfolk, England. The unit cow shed, fodder-room and double pigsty shown in Fig. 1 is 28′ long by 14′ wide and has two cow-stalls, a fodder-room, and two pigsties. The two cow-stalls are 12′ x 7′ 6″ and the fodder-room, 14′ x 6′. The divisions in the pigsties are 7′ x 7′, with a yard for each 7′ x 6′. In each yard there is a trough made entirely of concrete with a chute from the outside wall to these troughs, so as to avoid going into the pigs' yard at feeding time. From the fodder-room there is a feeding passage at the head of the cow-stalls; the manger is of reinforced concrete, and the Danish principle of having it low has been adopted. The walls are all built of concrete 4½″ thick, the size of each block being 18″ x 9″ x 4½″. The roof is of red concrete tile. The building is fitted with a concrete tank sunk in the ground, to which all the liquid manure is drained. This is a very essential point to the small farmer who keeps very little stock. The whole cost of this building was about $150, and it is interesting to note that it was erected in 14 days with the aid of one blocklayer and his laborer only. Figs. 2 and 3 show a double pigsty—front and rear views—the materials used in construction being the same in as the building previously described. The block and tile were made on the estate.





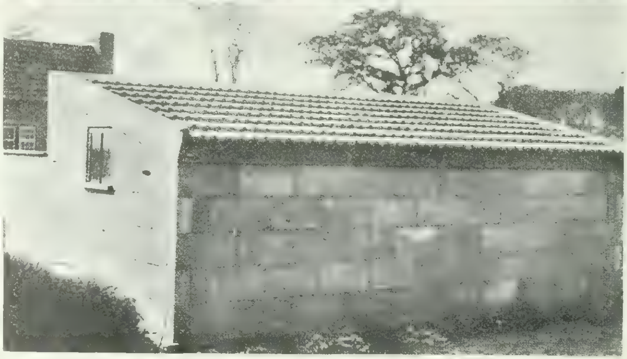


Fig. 1—Unit Cow-Stalls, Fodder Room and Pigsties
Fig. 2—Front of Pigsties
Fig. 3—Rear View of Pigsties

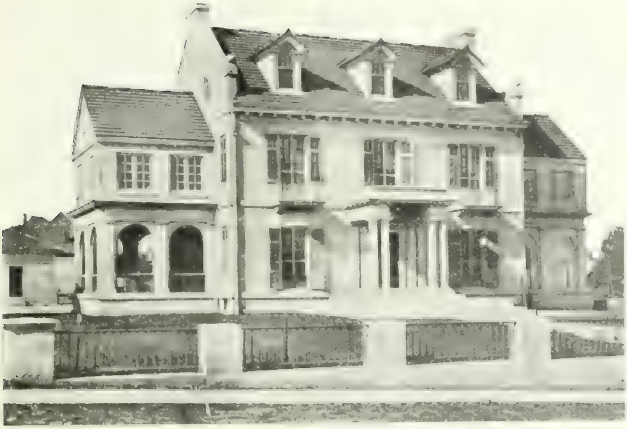


Fig. 1—A Fireproof Reinforced Concrete Residence in a Mississippi Lumber Town
This residence is the home of Charles Green, Laurel, Miss.; Debuys, Churchill, and Labouisse, New Orleans, Architects

House Built of Concrete—To Resist Fire Attack

In not many parts of the world is the fire risk greater from the outside of a house than from its interior, but in certain districts in which are situated great lumber manufacturing plants where the material for the great number of houses has naturally been of this same lumber, and where, in addition, as in the yellow pine country of the South, the lumber material itself is peculiarly inflammable, the protection needed is rather against sweeping conflagrations than against the usual household accidents. From this point of view, the special points of construction of the house herein described found their explanation. It is absolutely protected from fire risks from the outside, and from the especial danger points inside, and may serve as an example of economy in construction applied with an eye to the particular situation.

The walls of this dignified town house are of solid reinforced concrete, furred with terra cotta blocks. To guard against fire hazard in the cellar, the first floor is of reinforced concrete, with a hardwood floor laid over it. The roof is of red tile. The entire entrance porch, including the ornamental work and the side veranda, with its ornamental work, are of reinforced concrete; the porch laid, as are the walks, with a vitrified brick stamped in an ornamental pattern, and the veranda, laid with a white marble tile The balconies are slabs of concrete with iron railings, and the chimneys are of concrete entire, lined with vitrified flue lining.

The front porch was cast in place in special wooden forms made on the job. The ornament on the porch is solid concrete, cast in place in this way, and the roof of the porch is a solid reinforced concrete slab cast in place together with a solid parapet. The same thing is true of the concrete ornament of the side porch, and the solid concrete balls. The only ornament not concrete is that under the roof, which is wood.

The entire building was faced with a thin coat of Lafarge cement,[1] and sand, and the wooden ornament under the roof was painted to correspond, all a deep cream.

This house, recently constructed at Laurel, Miss., is the work of Benjamin A. Howes, engineer and builder, N. Y. C. Mr. Howes specializes in unburnable construction outside of the large cities, and the residence described is one of many which he has built along similar lines.

Timber appears only in the upper floors, the stairs, and in the rafters and in the ornament below the roof in the main building.

The fence is of massive concrete, with iron railings; and the whole is surfaced with a sand float in a deep cream color. The railings and blinds are painted the dull blue-green seen in Italian country houses and, with the red of the

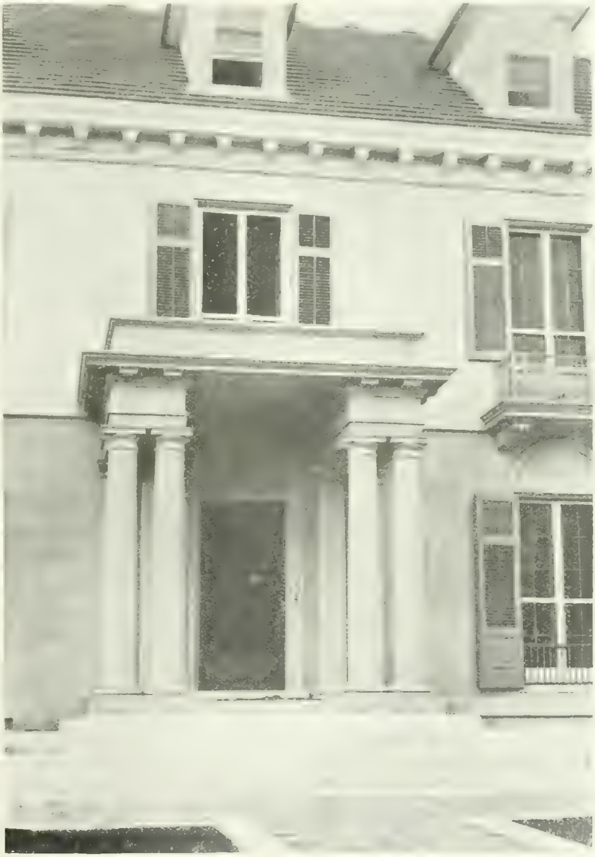


Fig. 2—Detail Photograph of Concrete Doorway

roof and the cream of the walls, make a very attractive color combination.

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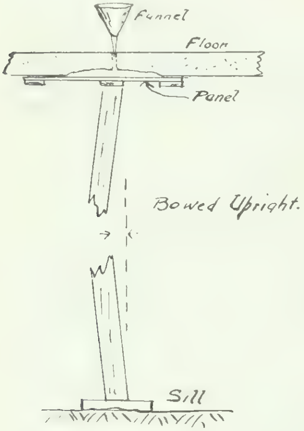
[1] Non-Staining Cement Co., N. Y. C.

The heating plant of this house is a furnace, to simplify the household labor, always a problem in the South. It may also be noted that the servants' rooms are in a separate building at the rear, shown at the left in Fig. 1.

One noteworthy point is the row of ridge tile with ventilating openings to cool the roof spaces in hot weather. It is found, indeed, that for the extreme heat of the southern summer, reinforced concrete is the ideally cool material. To this circumstance, and to its safety from the unusual fire risks in the South, is attributable the rapid increase in reinforced concrete construction for country houses throughout the South, and especially in the colonies on the east coast of Florida.

Method of Repairing Holes In Concrete Ceilings

Editorial reference is made in this issue to a method of repairing holes in concrete ceilings by pouring, through a hole drilled in the floor at the place to be repaired, a thin grout which is held in place by a light panel supported against the ceiling by an upright. The accompanying sketch illustrates the operation discussed.



Sketch Showing Arrangement for Repair of Concrete Ceilings

Mill No. 2, of the Vulcanite Portland Cement Co., Philadelphia, was put in operation in March, giving employment to an additional force of 200 employees.

Dealers in cement in Ohio report a widespread interest in building construction and a lively demand for Portland cement. With the actual opening of building activities, a higher price is looked for.

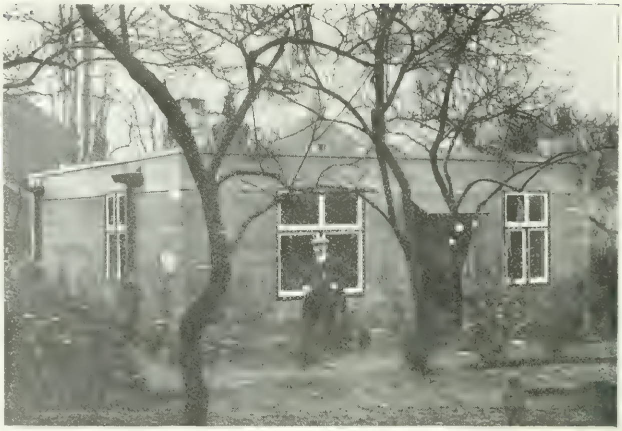


Fig. 1. A Low-cost Concrete Cottage at York, England

Industrial Cottages in England

The world over men are trying to build better dwellings and build them for less money. Rowntree and Co., York, England, have used reinforced concrete extensively in factory buildings, and as is usual under such circumstance, concrete was selected as the best material to use in building workmen's cottages. The accompanying notes and illustration show the work done along this line by W. J. Swain, the company's architect. In regard to these cottages, Mr. Swain, in a recent letter to Concrete-Cement Age, states:

The walls are composed of concrete, 9″ thick. In the ordinary course of events, I would have made these hollow, but as this cottage comes within the city boundaries I had to comply with the city by-laws. The roof was reinforced with wire, using about a 6-in. mesh As some of the spans were too great for 4-in. slab work I constructed stiffening beams on the outside. This was done by banking up the concrete in ridges, and putting more strands of wire and a few vertical stirrups to set as shear members. This of course is easily and cheaply done as it requires no timber nor joiner's work.

The experimental cottage, completed in Dec., 1912, has, all told, eight rooms, as follows:

Living Room	15′ 6″ x 12′ 6″
Scullery	9′ 3″ x 6′ 6″
Larder	5′ 2″ x 2′ 6″
Coal Room	3′ 6″ x 2′ 6″
Bath Room	9′ 3″ x 4′ 0″
Bedroom	11′ 6″ x 10′ 0″
Bedroom	9′ 0″ x 9′ 0″
Bedroom	9′ 0″ x 9′ 0″
Passage	15′ 6″ x 3′ 6″

The story height is 8′ 6″.

The following table gives the construction cost in detail. Some of the terms are not quite familiar to American builders, but in general, the parallel operation can be followed. The original table, in pounds, shillings, pence, has been converted to American currency:

Cost of Experimental Cottage, December, 1912

To Excavate and Clear Site		
Laborers, 11½ Hours		$ 1.40
Concrete		
Bricklayers, concreting	$22.14	
Laborers, concreting	53.34	
Carpenters, Sheathing	10.92	86.40
Sand	$13.86	
Mild Steel	10.03	
Portland Cement	88.82	
Gravel	16.30	
Gravel Pebbles	5.78	
Fine Slag	5.13	
Old Bricks	.18	
5 lbs. Elastic Cement	1.83	
Cartage	4.02	145.96
		$233.76
Brickwork		
Bricklayers' Time	$14.51	
Laborers' Time	8.57	23.08
1 Enameled Bath and Set Pot	$ 10.88	
1 3-ft. 6-in. Kitchen Range	8.65	
1 5-ft. 5-in. Soot Door, etc.	.69	
1 Sink 24½″x16″x4¾″ with waste comp.	2.07	
1 W. C. Pan, Seat, and Cistern	5.30	
400 Clamp Bricks, 74 Midd Bks.	3.45	
40 Fire Bricks 9″x4½″x1¼″	.59	
2 S. G. Stretchers	.20	
Pipe	.26	
Fine Slag	.26	
Cartage	1.46	
Sand and Gravel Pebbles	2.84	36.75
		$ 59.83
Carpenter Work		
Windows, Time Making	$ 13.07	
Time Fixing	2.34	15.41

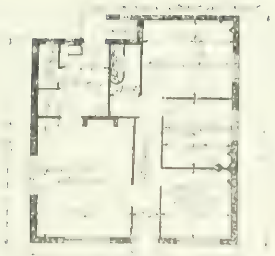


Fig. 2 [illegible] Cor- [illegible]

[illegible]	[illegible]	
[illegible]	[illegible]	
[illegible]	[illegible]	
183' 2-in. x 2-in. Sash Stile, 47' 2-in. x 3-in. Rail	3.87	
3 lbs. 4-in. Wire Nails, 2 lbs. [illegible]	[illegible]	
4' 3-in. x 4-in. Larch, 4' 2-in. x 3-in., 28' 2-in. x 2-in.	.67	
2 Prs. 1¾-in. Cast Butts, 7 lbs. 3-in. Cut Nails	.21	
12 Casement Fasteners, 12 doz. Openers	2.10	
[illegible]	[illegible]	
[illegible]	[illegible]	
Cartage	.18	[illegible]
		$ 28.25

Doors, Time Making	$ 7.23	
Time Fixing	1.46	[illegible]
[illegible]	[illegible]	
75' 1-in. x 7-in. Red, 25½' 1-in. x 6-in. do.	1.83	
58' ¾-in. x 5-in. Matching, 51' [illegible]	[illegible]	
101' 2-in. x 4-in. Red Frame, 44' [illegible]	[illegible]	
12' 1¼-in. x 9-in., 33' of 2-in. x 9-in.	.57	
[illegible] 17' [illegible]	[illegible]	
8 Sets of Latches, 1 gr. ¾-in. Screws	[illegible]	
9 Pairs [illegible] Hinges, 11 doz. ¾-in. Screws	1.32	
2 6-in. Locks, 2 Sets Door Furniture	[illegible]	
2 6-in. Tower Bolts, 5 Barrel Bolts	.20	
1 Letter Plate, 4½ lbs. 1½-in. Cut Nails, 10 doz. 1½-in. Screws	[illegible]	16.72
		$ 25.41

Floors, Cupboards, Porch, Etc., Time Repairing	$ 1.90	
Fixing	3.46	
Cartage	.18	5.54
35' 1½-in. x 7-in., 57' 1¼-in. x 7-in. Floor Bd., 32' Weather Bd.	$ 3.27	
1548' 1-in. x 3½-in. Red Flooring, 28 lbs. 2½-in. Nails, 11 lbs. 2-in. Nails	22.14	
18' ft. Angle Bead., 74' 2-in. x 9-in., 13' 1¼-in. x 5-in., 7½' 1¼-in. x 7-in. Mantle	4.81	
2' 1¼-in. x 2½-in., 2 1½-in. Jap. Cupd. Knobs, 2 1¾-in. Buttons	[illegible]	
3½ doz. [illegible]		
1¼-in. No. 9	.06	
[illegible] 4 2-in. No. 13 Screws, 2 3¼-in. No. 12	.20	[illegible]
		[illegible]

Painting

Painters' Time	$ 3.25	
2 lbs. White Paint	.12	
4 [illegible]	[illegible]	
5 lbs. Green Paint	.35	[illegible]

[illegible]

Plasterers' Time	$ 7.03	
Joiners' Time	2.50	
[illegible]	[illegible]	[illegible]
112 lbs. Plaster of Paris, 18-ft. Angle Bead.	$ .83	
176 lbs. Superfine Plaster	2.50	
[illegible]	[illegible]	[illegible]
		[illegible]

[illegible]

25' ½-in. Lead Pipe, 2 Joints.	$ 4.42	
9' ¾-in. Iron Pipe, 3 ¾-in. Elbows	1.83	
1 ½-in Cross Top Hot Water Tap, Refix Pipe to Copper	.85	
1 1½-in. Lead Bath Trap with Screw	.85	
12' 1¼-in. Lead Pipe to W. C. and Bath Wastes	2.92	
4 1¼-in. Solder Joints	1.46	
8 Pipe Clips and Screws	.34	
[illegible]		
Plumber 21 hrs.	4.26	
Commission on goods ordered by builders	1.34	
Glazing, 85 sq. ft. 21-oz. Glass.	6.43	
Glazing, 13 sq. ft. White Mur- [illegible]	[illegible]	[illegible]
		[illegible]

Summary

[illegible]		[illegible]
[illegible]		[illegible]
Mason Work		59.83
Carpenter—Windows	$ 28.25	
Doors	25.41	
Generally	36.08	
		[illegible]
Painting		4.20
Plastering		18.21
Plumbing and Glazing		[illegible]
Total		$433,42

Through Aman Moore, its president, the Portland Cement Co., with a plant under construction at Oswego, Ore., is protesting against the proposed 10-hr. bill. Such a measure would work hardships to the cement industry of the state, for the reason that, owing to its peculiar nature, the Portland cement industry requires long shifts, with close attention by experts frequently for at least 12 hrs. A number of states, through their higher courts, have already held that a law fixing the number of working hours is unconstitutional.

Cerro Gordo county, Ia., is active in preparing plans for permanent highways to be laid this spring. Concrete is obviously to be used.

Foreign Language as a Tool In Engineering Training

BY F. W. SCHOLTZ

One of the most difficult problems confronting the educator in the engineering school is instruction in modern languages. German and French, especially the former, have received very little attention by the engineering educators in their discussions on greater efficiency in teaching engineering subjects, and as a result, we find many schools struggling along with modern languages in their curriculums, but taught in such a way as to yield scant results, instead of giving the students the maximum benefit from the time and energy spent in these studies. Before discussing a practical course in this relation, however, let us first analyze the situation and recognize the difficulties confronting us.

In the first place, the modern language is looked upon as a minor study in engineering schools. Many of them carry German and French on the curriculum mainly because it is the will of the founder, or else because they believe that a little language thrown in on the side will not hurt the coming engineer. The various scientific and engineering departments share this view and as a result we have the languages crowded into second and even third place, and treated as an educational luxury rather than a necessity. The students, of course, have made up their minds from the start that they will never need the language, and that it is a waste of time to put in any more work than is absolutely necessary to pass the course. They cannot see far enough ahead to judge the use of the language in their future engineering work, and no amount of talking on the part of the modern language teacher will convince the majority that they are equipping themselves with tools that are to be used later on in life, if not immediately. Here, then, we have a fundamental and unconscious antagonistic feeling which prevents the student in many cases from putting the same amount of energy into the language study that he puts into scientific studies. Since, naturally, the student cannot get any more out of his studies than he puts in, he gains less from his studies in these subjects than he would if persuaded of their value. The first remedy will have to be a change in attitude on the part of the student body, especially, and this can be done only by gradually forcing upon the individual the consciousness that he is accomplishing something worth while. Towards this end we must shape the course, and in doing this, arouse his interest to such an extent that he will do the work required with good-will, and at the same time obtain practical results, which will dovetail into his experiences in the other scientific studies.

Having stated the theoretical solution of the problem, there remain the questions, whether or not and how this can be carried out in practice. The course of language studies mapped out in the following paragraphs has been inaugurated in one of our engineering schools and seems to meet the needs just mentioned. Whether or not it will be a practical solution of the entire problem, and will give the students a maximum amount of efficiency in the practical use of the foreign language, is a matter for time to decide; it cannot be determined at present. The fact remains, however, that the engineering school is on the right road, and that success is bound to follow progressive and determined attempts to reach the desired goal.

German, being recognized as the foreign language necessary for every good engineer, has become the major foreign language which all men in the school must study during their four years of residence. Those men who enter with two years of preparatory German, and this is the case of the majority, take freshmen German, which is given three times a week during the school year. Those men who do not enter with German take preparatory German during their freshman year; it is given five times a week throughout the year. In the sophomore year, the men take two hours a week throughout the year, and in their junior year, one hour a week. In short, every student is obliged to spend at least three years in the study of German. So far, the course does not differ very much from that at most other schools, except, perhaps, that most of them stop with the second year. The difference enters in the nature of the courses, which mark a series of graduated steps, taking the coming engineer from the easy scientific language through the more difficult popular technical language, to the extremely difficult technical or engineering German.

The freshman entering the school has, of course, literary German and the science necessary for entrance. In other words, his mental equipment consists of a general language vocabulary and some elementary chemistry and physics. The first half year he reads an easy scientific reader and becomes familiar with the chemical and physical terms in German, which are not difficult for him, as he easily finds the analogy between the scientific study and the reading matter in German. In addition to his reading and translation, he is made to commit to memory at each class session at least 10 words, which are selected with a view to their permanency of value for his future vocabulary as an engineer. Thus, the terms of the elements in chemistry and the general terms of light, heat, electricity and magnetism in physics become familiar to him, and through constant repetition become a part of his mental equipment.

The second half year, the work is made a little more difficult, leaving the realm of pure science and passing over into applied science. As there is no textbook on the market at present which meets the needs of the men, the department has prepared mimeograph sheets with vocabulary which are used in the place of a textbook. The subjects are somewhat on the following order: "America at work," the impressions of a German engineer on American methods; "The invention of Portland cement," a brief historical account to which are added some of the uses of cement; "Edison's new storage battery," an historical account of the development of this latest of Edison's inventions; "By-products in gas manufacture," a detailed account of the use of the various important by-products; "Electric power plants and power transmission for farms," an account taken from a German trade catalogue on this subject. These are only a few of the numerous papers read by the men in the course. It might be added that the material is kept up to date by extracts taken from current engineering journals, and that any antiquated articles are thrown out and replaced by the more modern ones on the particular subject. All of these are abstracts from some German engineering paper and are graded to meet the ability of the students. The practice of memorizing a certain number of words is still kept up, and the stock of words with which men become thoroughly familiar in one year may reach as high a number as 700, although it may probably remain nearer to 600. The object of this first year is to accustom the men to the general scientific and very easy technical German, and furnish them with a general vocabulary which will be partly scientific and partly technical. The second half of this year arouses their interest especially since it brings them in contact with articles taken from current technical journals. They see that they are studying work which is intimately connected with practical engineering practice and put more energy into their task than they would if it were merely textbook work.

We come now to the second year, where the men read a semi-technical German paper like "Prometheus," "Neueste Erfindungen und Erfahrungen," or "Technische Monatshefte." These papers are technical enough to give the engineering news from abroad and not too difficult for their understanding. After all, we must remember that many of these men bring a very small stock of technical knowledge to the school, and that any language too difficult would be merely words for them, void of any intelligent meaning. The selections in the above journal are short, are taken from almost every branch of engineering and are written to be understood by the layman. Naturally, these men, surrounded by an engineering atmosphere, have no difficulty in understanding what they are reading, and in case of doubt it is easy for the instructor to obtain some added information and explain the subject under discussion. Every man has his own paper to which he is obliged to subscribe and which he receives each month from the German publishers. This journal is used in lieu of a textbook, and is vastly more interesting and instructive to the men than the latter. Of course, the special study of a vocabulary goes on, except that the men learn 15 words at each recitation, instead of 10, so that their new vocabulary at the end of the year will be equal to that learned in the first year. This second year the men have become familiar with general engineering work. They know the literary style of the technical writers and have learned, in addition, a general vocabulary of engineering terms, which is necessary for every engineer, no matter what line of engineering he may take up. An added advantage lies in the fact that the students have no vocabularly compiled for them, as would be the case with a textbook, but that they are thrown on their own resources, and are obliged to learn the use of a dictionary. It takes time to acquire facility in the use of a dictionary, especially the use of technical dictionaries such as those of the six language series, and the more time the student can spend in their use the better it will be for him. After all, to use a dictionary does not mean to look up a word and take the one that seems to fit, but it means to use judgment and choose the term which is the exact counterpart of the German and is accurate from the engineering standpoint. The student must be taught the proper use of the dictionary and must be impressed again and again with the fact that the engineering accuracy is just as essential in making a translation as it is in figuring stresses and strains. There is one more art in which the student is trained during this year, and that is the difficult art of abstracting. Many men know how to translate an article correctly, but comparatively few have learned how to abstract well, or, in other words, take the essentials out of a long article and boil it down to perhaps one-tenth of the original volume. The student must not only be able to read an article correctly, but to give a very brief account of the essential points treated in the article and give a resumé of these in a few words. So far, we have treated general engineering practice only. It is in the third year, when the men branch off into electrical, mechanical or civil engineering, etc., that they work in special lines of engineering in their language study.

The third year finds the average student who has had the course just described ready for the regular engineering journal. Great care must be used in the choice of a German paper. Its articles must be varied to meet the requirements of the different men; they must be written in the exact terms used by the practical German engineers; they must be short enough to be easily handled, since the men have a heavy schedule, and meet once a week only for class room work. Such a journal as "Der Ingenieur" seems to be ideal in this respect. It is an engineering digest, covering the principal branches of engineering, brings the current engineering news from all over the world, and has these articles abstracted, giving the essential elements only. The entire junior class has been subdivided according to their special subjects in engineering. This year we have mechanicals, electricals, mining, civils, and chemists. Each section has between 12 and 18 men, which allows easy handling and more personal work than would be possible with a larger number. The work is, in part, equivalent to the seminary work in the graduate schools of our universities, in other words, it aims to be individual. Those men who are only fair in German, read the articles relating to their own line of work only; those men who are excellent and can afford a little extra work, are given longer and more difficult articles, which train them to do the hardest kind of engineering translation possible. They prepare abstracts of those long articles, taken, say, from "Elektrotechnische Zeitschrift," or a similar paper, and discuss them in the class. The point in specializing with the juniors is simply this: They have obtained a general knowledge of foreign engineering terms in the previous years, and need special terms which relate to their own kind of work. By reading electrical articles with the electrical section, mining articles with the mining section, and so on, the men are trained in the work which is to be part of their life work, and which, therefore, calls forth their main interest. The knowledge obtained in the engineering class room helps them in the language work, and, vice versa, the knowledge obtained through the articles may help them in their engineering work. Their interest is aroused by the interaction between the two elements of study and they do better work, since they can see practical results. Of course, the training in abstracting continues, as does the study of a vocabulary, with one difference. The vocabulary is now a special one, fitted to the ultimate needs of the students in their various lines of work. If we review the results obtained in this one point alone through the three years of language study, we shall see that the student has obtained a general scientific vocabulary in the first year, a general engineering vocabulary the second year, and a specialized engineering vocabulary fitted to the individual lines of work the third year. He is, therefore, well equipped along this line to read any article in the engineering journal which is within his grasp from the point of view of subject matter. More than that, he has been taught to run his eye over the entire article and to read and abstract it, rather than to make a translation pure and simple.

Finally, a few words in regard to possible variations in the details of conducting these courses, and to supplementary work. There is no end of material, if only we look around for it. Thus, for example, the trade catalogues of such firms as the Allgemeine Elektricitätsgesellschaft, or the Siemens-Schuckert Werke offer excellent material for reading, as has been found in this case. Most German engineering firms are glad to send their publications in the interests of education and do all within their power to further this work. Blue prints, prepared by the mechanical drawing department, can be used to teach the parts of an engine, or of a blast furnace, using the equivalent German and English terms.

As regards supplementary work, it has been found good practice to vary the work by giving the men lectures on German institutions, customs, political life and industrial development. Every year a course of illustrated lectures is given, which acquaints the men with phases of German national life with which they are not familiar and this rouses a kindred spirit in them. In addition, a 15-minute talk is given each week on some phase of German industry or engineering development, showing them the tremendous resources and progressive spirit of the German nation. Among these talks or lectures may be mentioned a history of the growth of the great Krupp steel works, aided by the centenary edition of a memorial volume donated by the Krupp Co., an account of the German engineering schools, of the testing laboratories near Berlin, and similar matters of interest. These are welcome changes for the students and teach them that there is much worth while learning from a foreign country, a fact which few of them realize.

In closing, it may be said that the above is not a theoretical account of work to be tried in the dim future, but is a practical course pursued on the above lines. The ultimate results lie, of course in the future, and whether or not this solution will be the right one for the language problem in engineering schools can only be shown in years to come.

Book Reviews

Reinforced Concrete Construction. Fundamental Principles, Vol. I, by George A. Hool, S. B., Assoc. Prof. of Structural Engineering, Univ. of Wis. Prepared for use in the extension division of the university. 6⅜" x 9⅜". 254 pp., 7 illustrations, 57 figures, 15 diagrams and 16 tables. Cloth. McGraw-Hill Book Co., N. Y. C. Price, $2.50.

This volume, the author states in his preface, forms the first part of the regular correspondence course on reinforced concrete construction offered by the Extension Division of the Univ. of Wisconsin and presupposes a knowledge of the elements of structures. The complete text for this course has been divided into three sections. The present volume treating of the fundamental principles is to be followed by a second on the detailed design of retaining walls and buildings and a third upon the design of bridges and miscellaneous structures.

In the volume in hand the author has outlined the properties of concrete and steel and the advantages to be derived from their intelligent combination. He then takes up the theory and design of rectangular beams, slabs, T-beams and columns. Each chapter gives some well selected problems exemplifying the application of the principles covered. This portion of the work is followed by tables and diagrams which will prove useful to the designer. A chapter upon combined bending and direct stresses closes the volume. This last chapter analyzes those eccentric stresses which are common in actual structures but not commonly treated in text books.

In this volume Mr. Hool has succeeded in producing a work which is clear, logical and concise. The subject is taken up from an initial assumption and carried forward step by step, directly to a conclusion. The author does not indulge in those sudden and inexplicable wanderings off into side issues, blind alleys and devious ways which are characteristic of many of the engineering text books on this subject. He has not sought those minutely accurate formulas, in the case of T-beams, which carefully take into account the compression in the portion of the T above the neutral axis and neglect the fact that the compression stresses are not and cannot be uniform across the entire section of the top of the T. In preparing this work Mr. Hool has evidently availed himself of many sources of information, but he has not been a copyist. He has analyzed each item, discarding the worthless gangue and selecting the fines, has concentrated them into a thoroughly worth while book.

The treatment of shearing stresses or diagonal tension and the method by which the amount of reinforcing necessary to provide for these stresses can be arrived at, are extremely lucid and logical. The mathematical analysis of this subject has been reduced to simple and readily comprehended terms.

Bending and direct stresses is the title selected by the author for his analysis of eccentric stresses. This is not an easy subject to reduce to simple terms. Mr. Hool, however, has succeeded in getting rid of much of the ambiguity of this subject.

Mr. Hool's book is intended for a text book, but it has a distinct value to the designing engineer who desires concise data.

* * *

Hand Book for Highway Engineers; by Wilson G. Harger, C. E., and Edmund A. Bonney. 493 pp., 4¼"x7", limp leather binding, illustrated; $3.00 net. McGraw, Hill Book Co., New York.

This pocket size hand book is in two parts. The first is devoted to theory of design and the second to practice and construction. Mr. Harger is First Assistant Engineer of the New York State Department of Highways, and Mr. Bonney is Chief Draftsman, Division No. 5, New York State Department of Highways. It contains many computation tables and numerous cost data. Various chapters of the book are devoted to grades and alignments; sections, drainage, foundations for broken stone roads, top courses, covering work as follows: waterbound macadam, waterbound macadam with surface treatment, rock asphalt, brick pavements, stone block pavements, concrete pavements, small stone cube pavements, McClintock cube pavements, and Rocmac; guard-rail, curbs, retaining walls, materials. Part 2, survey, office practice, cost data and estimates on macadam roads, earth excavation, rock excavation, unloading broken stone, hauling, loading fence stone, loading filler sand, spreading filler and binder, spreading crushed stone, placing boulder stone, ratio of loose to rolled depths, amounts of filler and binder and rolling, crushing, brick pavement on country roads, notes on construction, specifications and methods of construction.

Directory of Cement, Gypsum and Lime Manufacturers. Cement Era, 538 S. Dearborn St., Chicago. 5"x3", leather bound, [illegible] pp., with [illegible] Seventh edition, 1913.

There are 159 Portland cement mills listed in this directory, of which 132 are reported as operating, 22 under construction and five under finance. The location of these mills, their officers and executives, are printed in detail, together with reproduction of a number of brand marks and insignia.

The remainder of the directory is dedevoted to lists of gypsum companies, lime companies, and advertisements, which represent a buyer's guide of the industries included in the statistics.

The book is neatly published and forms a handy volume of reference.

Concrete Organizations, Officials and Conventions

National Association of Cement Users, Edward E. Krauss, Secretary, Harrison Building, Philadelphia, Pa.

Association of American Portland Cement Manufacturers, Percy H. Wilson, Secretary, Land Title Building, Philadelphia, Pa.

American Highway Association, J. E. Pennybacker, Jr., Secretary, Colorado Building, Washington, D. C.

Northwestern Cement Products Association, J. C. VanDoorn, Secretary, Security Bank Bldg., Minneapolis, Minn.

Cement Products Exhibition Co., 72 West Adams St., Chicago, Ill.; Secy.-Treas., J. U. C. McDaniel, 108 La Salle St., Chicago, Ill.

Nebraska Cement Users' Association, Secy. Treas., Frank Whipperman, Omaha, Neb.

Iowa Association of Cement Users, Henry H. Dean, Glenwood, Ia., Secretary.

Canadian Cement and Concrete Association, William Smith, Secretary, 57 East Adelaide St., Toronto, Ont.

Omaha's third concrete show, held under the auspices of the Nebraska Cement Users' Association, was held at the Auditorium, February 4-8, and was successful in the extreme. An average of 1,000 daily saw the show, which was diversified and interesting. Moving pictures of construction work in the Panama Canal and a band concert every evening helped make the show attractive.

The organization of cement users met at the Rome Hotel, Feb. 5-7, and heard a number of practical and useful papers on subjects relating to cement and concrete. There were about 225 members in attendance—a very satisfactory showing. It is planned to enlarge the scope of the organization next year and to change the name to Nebraska and Mid-West Cement Users' Association. The following officers were elected for a year:

President, Peter Palmer, Oakland; Vice President, G. F. Lillie, North Bend; Secretary-treasurer, Frank Whipperman, Omaha. Directors, John Apple, Red Oak, Ia.; W. T. Nelight, West Point; H. R. Park, Bruning.

Members of the Inter-State Mantel and Tile Dealers' Association, in session at Detroit, February last, elected the following officers: President, Robert Beck, Chicago; first vice-president, George T. Eubanks, Atlanta; second vice-president, R. L. Pollvogt, St. Louis; treasurer, Thomas J. Foy, Cincinnati; members of executive board, J. W. Lantry, N. Y. C.; F. L. Graf, Pittsburgh; W. J. Northcross, Memphis. New Orleans was selected as the place at which the 1914 convention will be held.

At the annual meeting of the stockholders of the Southwestern States Portland Cement Co., held at Dallas, Tex., Feb. 11, the following officers were elected: President, C. H. McNider, Mason City, Ia.; Vice-president, T. H. Dinsmore, N. Y. C.; Vice-president, C. H. Wagner, Minneapolis; Treasurer, C. I. Jones, Lincoln, Neb.; Secretary and General Manager, H. R. Breck, Dallas.

Additional Notes on Double-Wall Machine Construction

On page 43 of the January issue, 1913, the construction of a three-story six-family dwelling at Stamford, Conn., was described. The walls were built with a Van Guilder wall machine and Edw. L. Pond, of the Van Guilder Hollow Wall Co., Rochester, N. Y., sends on the following additional notes.

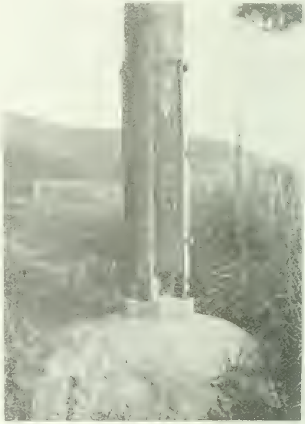
The materials used were screened crushed rock, 1/4" to 3/4" size, sharp sand and Portland cement, mixed 1:2:4. The double walls were tied together every 2' with 1/4-in. galvanized steel ties turned up at the ends, and each of the double walls was reinforced horizontally with 1/4-in. galvanized steel rods placed in every 9-in. course of concrete around the building. The front corners and the chimney were built with a Van Guilder pilaster attachment. The window sills and lintels were made in wooden forms placed on the walls, filled with concrete and tamped.

Another way to have made the straight lintels and sills would have been to make them in a Van Guilder machine on a floor with a reinforced rod running along the center of the sill. They can be made in this manner as fast as the machine can be filled and tamped, as they do not need to remain in the machine to set.

For building roofs, it is practical to use any system of concrete roof construction that can be used with brick or any other kind of walls in connection with these walls.

Method of Protecting Wooden Poles Against Decay

The accompanying photograph shows a method of protecting wooden telegraph poles against decay. In doing this a concrete base is used into which are inserted four steel uprights. A convenient section of steel member is used. After the concrete is set the base of the wooden pole is bolted inside of these steel uprights as shown. This method is used extensively at the Hiedelberg Cement Co., Hiedelberg, Germany. The photograph and notes are forwarded by Dr. Otto Schott, N. Y. C.



Details Showing Application of Concrete Base to Wooden Telegraph Poles

The Oshkosh Manufacturing Co., Oshkosh, Wis., announces that its Chicago office, newly opened, will be located at 1452 Monadnock Blk. A. M. Anderson will be district manager in charge. This company handles a complete line of contractors' machinery and equipment.

Contract has been awarded by the county board of supervisors, Milwaukee, to the Universal Portland Cement Co., for cement to complete county roads and bridges. It is estimated that 100,000 bbls. will be required. More than 30 miles of road will be built.

The Construction of Gravity Concrete Chimneys

BY R. S. DRAPER*

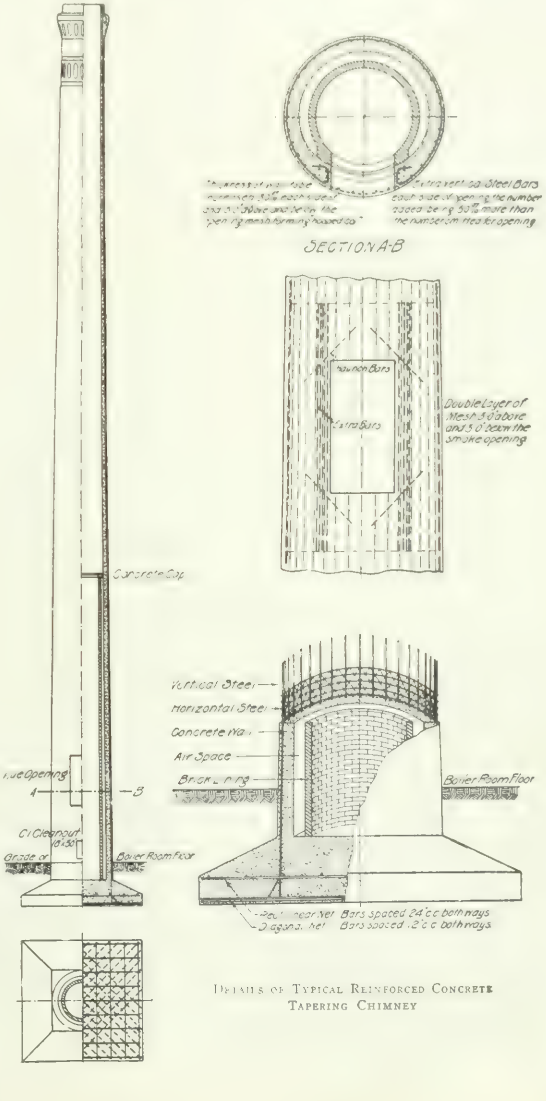
Reinforced concrete chimneys have been so widely employed in the past 10 years and the subject has been so ably covered in engineering literature, that but little remains to be said, beyond calling attention to their increasing popularity and proven permanence. However, a new type has several times been employed on important works, and while considerably more costly than the generally accepted design, has been given preference by a few consulting engineers, owing to the fact that its particular features practically eliminate danger from the personal equation in the builders, and also greatly increase the safety factors.

We refer to the "gravity" chimney, so-called by reason of its stability at all points being dependent upon weight alone, the prime requisite of the design being that the moment of stability at any or all sections exceed the wind moment. There would thus be no resultant positive bending moment, hence no tensional strain to be absorbed by the vertical reinforcement, other than that resulting from temperature changes without and within the structure.

The first "gravity" chimney of reinforced concrete was built for the Muncie Electric Co., at Muncie, Ind., 258′ in height over all, with a minimum inside diameter of 14′ 6″ inside the lining. The shaft has a uniform taper, and is 25′ 3″ in diameter at the base outside, and diminishes at the rate of 2″ in 5′ to an outside diameter of 16′ 10″ at the top. The inside diameter diminishes at the rate of 1½″ in 5′ from 21′ 9¾″ at the base to 15′ 6″ at the top. The wall thickness diminishes at the rate of ¼″ every 5′, from 20⅝″ at the base to 8″ at the top. This chimney had a nominal inside diameter of 14′ 6″ and the inside diameter of the concrete wall at the top provided 1′ more than this, which made provision for an independent lining of fire brick, extending the entire height of the chimney. The fire brick usually used are 4½″ in width, which leaves an air space of 1½″ on the inside of the concrete wall at the top. The lining on the Muncie chimney was carried plumb its entire height, and was divided into three equal divisions of about 85 ft. each, of 13″, 9″, and 4½″ wall. The 4½″ wall and the inner 4½″ of the 9″ and 13″ wall consisted of fire brick, and the backing consisted of a hard burned red brick of a less refractory clay. The lining was further supported by six pilasters, equally spaced, bonded into the fire brick lining, and extending into the insulating air space, but clearing the inside of the concrete wall by 1″, permitting free and independent expansion of lining.

Two diametrically opposite openings 13′ high and 8′ wide were left for breeching connections, the stack being located midway between two batteries of boilers. A baffle plate of reinforced concrete extends diagonally across the line of breechings, and extends 10′ stack at an angle of 60° from the center above the top and 10′ below the bottom of the openings, being keyed into the lining. The concrete wall is made considerably thicker on all sides of the flue openings, the additional width of wall extending into the air space inside, and this compensates for the compressive area of concrete cut out for the openings. At the sides of the openings, additional vertical steel is provided to carry the temperature stresses from above and below the openings, past that point. Diagonal bars are provided at all corners of the openings to prevent cracking at those points, and to serve the purpose of forming approximate arches of the reinforcement. The stresses used are conservative, 16,000 lbs. for steel in tension and 350 lbs. for concrete in compression.

The mesh reinforcement used encircles the vertical reinforcement from bottom to top of shaft, and is tied to it at intervals. The vertical reinforcement consists of square twisted bars varying in number, diminishing as the top is approached, but in no case more than 18″ apart. These serve for reinforcing against temperature stresses only, as the chimney is of true gravity design and there is in no place a bending moment resulting from wind pressure.


Concrete Cap
Flue Opening
A
B
CI Cleanout 16"x30"
Grade or
Boiler Room Floor
Extra vert. sq. Steel Bars each side of opening the number added being 50% more than the number omitted for opening
SECTION A-B
Haunch Bars
Extra Bars
Double Layer of Mesh 5.0 above and 5.0 below the smoke opening
Vertical Steel
Horizontal Steel
Concrete Wall
Air Space
Brick Lining
Boiler Room Floor
Bars spaced 24" c c both ways
Diagonal Net Bars spaced 12" c c both ways

Details of Typical Reinforced Concrete Tapering Chimney

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*Contracting Engr. General Concrete Construction Co., Chicago. This company designs and builds tapering concrete chimneys of the type described

Glare from Concrete Pavement Avoided by Lampblack

BY M. G. BENNETT*

In many sections of the country concrete pavements are meeting with damaging criticism which is entirely unnecessary, because it can easily be avoided. This criticism is due to the practice of laying the pavements in the natural color instead of toning down the surface coat so as to reduce the reflection of light and heat. Cement manufacturers and contractors should take a much greater interest in this question, because brick and similar pavements are not subject to the same criticism, and with very little care concrete pavements can be given a cool, non-reflecting surface that is even less objectionable and much more pleasing from an aesthetic point of view than these other pavements. If the practice continues it is certain that oculists and physicians will begin to voice their complaints on account of the eye strain caused by reflection of sunlight in hot weather and this is especially true of the South and Southwest where this bad habit almost universally prevails. If the doctors do get started there is danger that the concrete pavement will get a black eye and the ounce of prevention in this case is of great importance and it is easily provided because a very small amount of pure lampblack used in the surface mix will entirely obviate the trouble and give an agreeable slate-colored tone that will reflect light and heat to a very slight degree only and will be restful instead of trying to the eye.

Snapshot of One . the Principal Streets in Oklahoma City, Taken in May, 1911

The accompanying illustration shows the condition in the Southwest. It shows one of the principal streets of Oklahoma City, and although the halftone screen has toned down the reflection, it vividly demonstrates what the inhabitants of that and other cities are suffering without as yet realizing the cause. For example, a motorman in Oklahoma City whose car ran mostly through a new avenue which had recently been constructed and paved with concrete, said that he knew that his eyes were being injured, but did not realize the cause until it was pointed out to him and then he easily recollected that he had not been troubled until he began to run on this concrete street.

Many cities and towns have adopted ordinances requiring the admixture of lampblack with the surface coat in all sidewalks and streets and a great many others have adopted the practice without any official action requiring it, because it seemed the good sense thing to do. The cost is insignificant. From 1 to 2 lbs. of lampblack to each barrel of cement, depending upon the depth of shade required is all that is necessary. Around Boston the specification cals for 1 to 2 lbs. per bbl. of cement. In Portland, Ore., the municipal specification is as follows: "To each bbl. of sand used in mixing the wearing surface, 1 lb. of dry lampblack shall be added. The dry lampblack shall be mixed with the sand before mixing with the cement."

This black is put up in 1-lb. paper packages and is sifted from the package into the mix and worked thoroughly through it in the mixing, or it is mixed with the sand beforehand. The coloring power of the lampblack is so great that this quantity thoroughly stains the mixture and does not weaken the bond Weaker colors, such as reds and browns, cannot be used with the same success, because in order to get a good color such large quantities have to be used that the bond is pretty sure to be weakened. This is also true when weak imitations of lampblack are used, containing charcoal or ground coal, or lampblack heavily adulterated with these or similar minerals. Their coloring power is very slight and while they are sold at lower prices, they are actually much more expensive than pure lampblack.

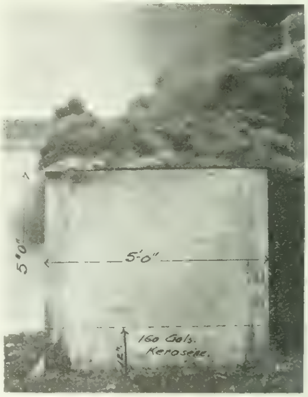
A reform so simple as this and of such ultimate importance should not be delayed, and as it happens the sections that are the worst offenders are those in which the reform is most important, that is, in the South and the Southwest, where intense heat and strong sunlight prevail for long periods. The cost of the operation is so slight that contractors do not object to it as soon as they have tried it and observe the result, and it has another important advantage to them, in that it enables them to get a uniform tone even though their cement may sometimes vary in color.

The brick people are nothing if not enterprising. At the clay products show to be held in the Coliseum, Chicago, Feb. 26-Mar. 8, there will be a brick house among the exhibits. The Clay Products Exhibition Co., in charge of the exhibit, suggested to all prospective exhibitors and other interested people that each man should send one or two bricks by parcel post, to be used in constructing this house. About 25,000 brick were required by the plans, and if they are all furnished as requested the Chicago postmen must be equipped with hods. As a matter of publicity for the exhibit, scarcely anything better could have been devised. Our hats are off to the man who conceived the idea.

Fire Test on Concrete Tank at Singapore

The efficiency of reinforced concrete as a fire-resisting material is being demonstrated everywhere by test and actual service. The accompanying illustration shows a test of a concrete tank recently constructed at Singapore, Straits Settlement, by the firm of Howarth Erskine, Ltd. The following notes covering the log of the test are taken from the official report:

The inside dimensions of test tank were 5′ x 5′ x 5′; the walls, 3″ thick, plastered on No. 24 gauge four rib "Hy-Rib,"[1] extending horizontally; the corners were reinforced with 2¾-steel angle. The mixture of plaster used was 5 cement; 12 sand; 1 lime paste. "Trus-Con"[1] waterproofing paste was used in the water.



Using Kerosene For a Fire Test on a Concrete Tank at Singapore

At time of the test the age of the tank was 29 days; water had filled the tank for two weeks before test, i. e., when the tank was two weeks old only. No leakage whatever occurred.

After emptying the tank, 160 gals., (about 12 in. in depth) of kerosene was poured in and ignited. The flames rose high above the tank, which resembled a roaring furnace with terrific heat. The deflections at the center of the side were as follows:

Time	Deflections
Burning 10 min.	1/16″
Burning 16 min.	1/16″
Burning 45 min.	1/16″
Burning 1 hour	1/8″
Burning 2 hours	3/16″
Burning 2¾ hours	3/8″

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*Samuel Cabot (Inc.), Boston, Mass.

[1] Trussed Concrete Steel Co., Detroit

During the entire 2¼ hours, neither oil nor flames penetrated the walls. The tank, while still very warm, was filled with water up to 18″ below the top. Water leaked out of some of the cracks, but the walls maintained their strength and elasticity against the water pressure.

The metal mesh was not damaged, and the outside of the tank was perfect, except for a few cracks. It is of interest to note that the tank had contained water for two weeks, and that the enormous heat was immediately applied to the damp surface.

Railway Shop Construction in Savannah

The Seaboard Air Line Ry. has recently completed at Savannah, Ga., railway shops, using concrete for foundations and curtain walls and roofs. The work consists of a machine, boiler, blacksmith and erection shop, combined, 113′ x 132′, a power house 41′ x 66′, and a 10-stall round house about 80′ x 270′.

The round house adjoins and connects to the north side of the machine and boiler shop, but the power house is an entirely separate building. All of these buildings are of steel frame-work on concrete foundations, the side walls consisting of concrete pilasters, panels filled in with an 8-in. plain concrete wall 4′ high. Above this height (Fig. 1), the steel frame construction is used, with steel sash and steel rolling doors. The curtain wall construction is 3″ of concrete applied over "Trussit."[1] The round-house is of reinforced concrete and steel sash throughout, the panels being the same as on the other building.

The 4-ft. section of the walls is of plan concrete mixed 1:3:5, as are all of the pilasters and casings for struts. The aggregate used was crushed stone or gravel to pass a 1-in. ring.

The panels of expanded metal were made as follows: 24-gauge "Trussit" was erected with ribs running vertically, sheets thoroughly wired together and carefully wedged in place in grooves in the concrete columns and struts prepared to receive them. On the outside of the wall the first scratch coat of plaster consisted of 5 parts of Portland cement, 12 parts of clean sharp sand, 1 part of lime paste with long cow hair added. While this coat was still wet it was scratched over the surface, forming a key for the finish coat which was added after the first coat was hard enough to hold it. Finish coat was the same as the scratch coat except that a waterproofing paste was added in the proportion of 1 part paste and 12 parts water. The thickness of the waterproof mortar was ¾″, and the total thickness of this outside coat, 2½″. The inside finish was then applied of the same mix as the first outside coat, making the wall a total thickness of 3″. It was further required that the finished wall should be protected and kept wet for at least four days with wet burlap or canvas.

The roofs of the erecting shop and blacksmith shop are flat roofs, and the roof over the machine and boiler shop is a saw-tooth roof. All these roofs were covered with a 3-in. slab of concrete, reinforced with 24-gauge "Self-Sentering"[2] in a manner similar to that in the warehouse, except that the ribbed side of the fabric (the top), was covered with 2½″ of concrete made of 1 part Portland cement, 2 parts sand and 4 parts crushed stone or gravel passing a ½″ ring. The under side of the roof was later plastered with ½″ of cement mortar made of 2 parts cement, 4 parts sand and 1 part lime putty, together with sufficient hair to make a key. The ribs of the metal mesh run with the slope of the roof and joints were broken at the purlins only.

Surveying Instruments

Building contractors are finding out more and more that the use of levels and transits on construction work is economical. W. C. Stafford, Marion, O., writes as follows:

I have used architect's levels for a number of years, and could not possibly get along without one. I use mine on all kinds of work, finding levels for walls, joists, window sills, grades for yards, drainage, and in fact everything that calls for accurate work, and I find it a time saver, and money maker. I now have a convertible level, an up-to-date instrument for squaring buildings, there are several makes on the market, and every up-to-date builder should own one and get out of the old rut of level and straight edge.

Hudson's Bay $2,500,000 Store at Vancouver

Contract for constructing the eastern wing of the Hudson's Bay new department store building Vancouver, B. C. was recently awarded to Rourke, MacDonald & Moncrief, building contractors, Vancouver. As noted in a recent issue of the *Daily Consular and Trade Reports*, the estimated cost of the entire building is $2,500,000. The present contract of about $900,000 is for an addition to the present store, and when completed the business will be transferred to the new portion of the building while the balance is being erected. The part covered by the present contract will be finished this year and the entire building ready for occupation prior to the end of 1914. The store will cover an area 150′ x 260′, will be 10 stories in height, and have two basement floors. It will be of steel and reinforced concrete throughout. The exterior will be faced with terra cotta.

It will have its own heating, lighting, and refrigerator system, obtaining water from artesian wells, and it is intended to make it a modern department store in every respect. A system of ventilation will be established by which fresh air will be drawn from the outside, passed through a filter and purifier, and then circulated through the building, the air having been previously heated or cooled according to the season of the year.

Under the present arrangement, should the contract for this portion of the building be completed satisfactorily, the same contracting firm will be given the balance of the contract.

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[1] The General Fireproofing Co., Youngstown, O.

[2] General Fireproofing Co., Youngstown, O.

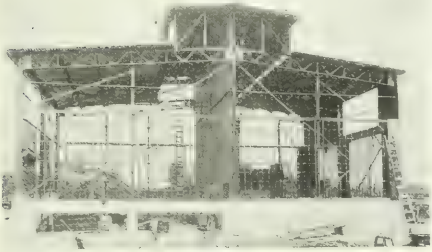

Fig. 1—The Power House Under Construction Showing Solid Base Wall and Light Upper Construction

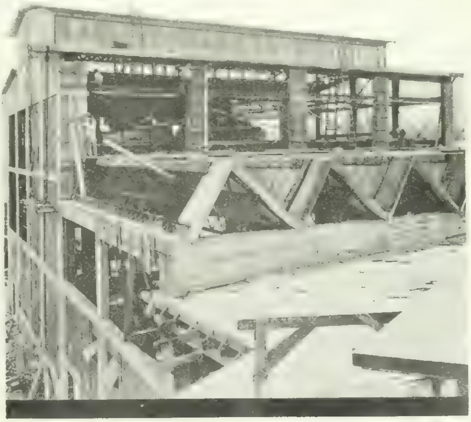

Fig. 2—Saw-Tooth Roof Construction Using Structural Steel, Ribbed Mesh and a Concrete Slab

Protecting Piles Against Teredos and Limnoria

BY O. P. SHELLEY, JUN. A. S. C. E.*

In many parts of the United States and most notably along the Pacific coast, teredos and limnoria have proved the greatest possible menace to wooden piles; untreated piles have been eaten through in three years and creosoted piles have fared but little better. For these reasons great ingenuity has been exercised to devise some permanent and satisfactory way to protect wooden piles from the ravages of these ocean pests.

Inventions along this line have included covering with sheet copper, coating with plaster, covering with concrete, wrapping with burlap and compounds, and innumerable other devices, all of which have proved either too costly or ineffective from one cause or another. The most promising line of endeavor and therefore the one along which most attempts have been made has been concrete coatings, but these have been ineffective owing to the fact that none has yet been devised that would stand the shock of driving without cracking or flaking off.

In one notable instance (a large pier on the San Francisco water front, built by the State Harbor Commission), the piles were first driven to refusal, cut off and a separately cast reinforced concrete cylinder was slipped over the pile and the space between pile and cylinder filled with sand. This scheme, while pleasing theoretically, was impracticable as the thin cylinders almost inevitably cracked under handling; the weight and cost of the cylinders were almost as great as for solid concrete piles and there is always the danger of the water scouring the mud at the base of the cylinders sufficiently to allow the marine pests to get in their deadly work.

Much work has been done in trying to cast concrete coverings around piles after the latter are in place, but the pouring of concrete through water into a thin shell, so as to embed reinforcement gives such uncertain results as to be unsatisfactory; also there is the still greater uncertainty of the coating being properly covered at the mud line.

Concrete piles are not altogether to be desired, apart from their cost, for on the Pacific coast it is often necessary to use 70-ft. piles owing to the unsatisfactory nature of the mud bottom and the extra weight over wood piles is often prohibitive.

To overcome these troubles, Lilley and Thurston, San Francisco, have developed and applied for patent on the "Gunite Coated" pile. This consists of coating the pile for a length to reach from below the mud-line to high-water with a cement mortar, applied with the "Cement Gun,"[1] over a suitable reinforcement and driving the piles after the "coating" has hardened sufficiently. The reinforcement, which was designed by the writer, is clearly illustrated in Figs. 1 and 2. This reinforcement had to perform the double function of reinforcing the coating before, during and after driving and to be of such small mesh as to make it possible to build up the "Gunite" during the shooting. It consisted of seven ¼-in. round rods equally spaced around, and stapled longitudinally to the pile. The rods were held away from the pile about ½ in. by lugs. Around the pile and over these rods was then wound spirally a continuous band of style No. 6A triangle mesh fabric[2] in 12-in. widths, the bands being lapped 2" and the fabric being thoroughly stapled along all laps with 2-in. fence staples. The "Gunite" was then shot onto the pile (Fig. 2), to a depth of about 1⅛ in. The coated pile (Fig. 3), is kept wet down for several days and is allowed to set for about 30 days before driving. During the process of coating the pile is carried on rollers, allowing it easy rotation.

The coated length of the piles should never run over 40% of the total length of the pile and may often be much less; this keeps the *cost per pile* down to a very low figure and the weight of the coating would (for average piles) be only 60 lbs., per lin. ft., of the coated portion.

Early in July, 1912, quite a number of piles were coated by the Lilley & Thurston Co., for the United Engineering Works, Alameda, Cal., and were driven from time to time in the latter part of August with a great success.

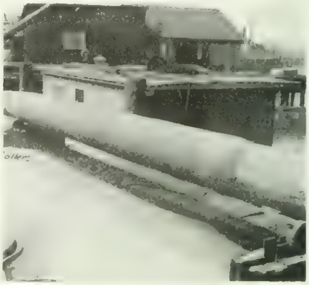

Fig. 3—A Pile Ready for Driving

It is certain that this coating can be contracted for at from $1.25 to $1.50 per lin. ft., of *coated portion* according to the sizes of the job, and facilities for handling the piles. The costs on the work mentioned above are as follows, but do not include profit, overhead charges, nor the cost of handling piles to and from the water:

Cost of reinforcement per lin. ft of coating	$ .181
Cost of labor per lin. ft. of coating	1.39
Cost of sand and cement per lin. ft. of coating	.222

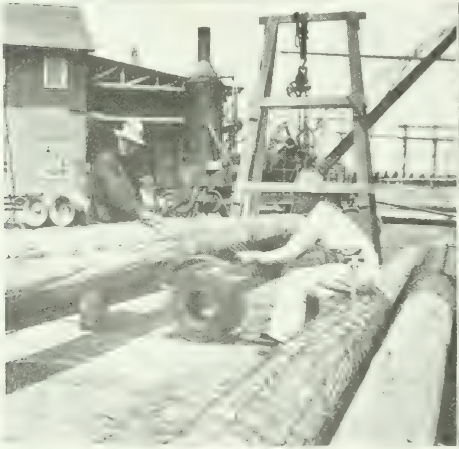

Fig. 1—Placing the Reinforcing Fabric Around a Timber Pile

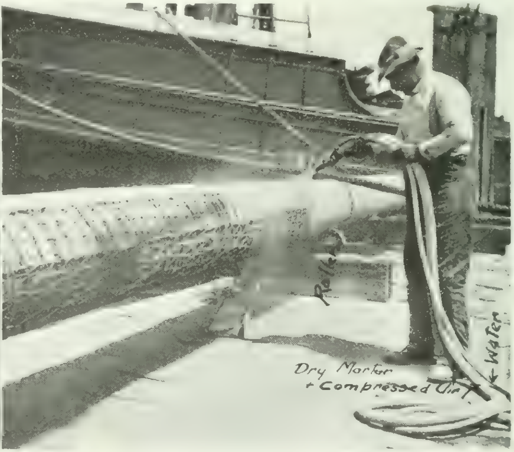

Fig. 2—"Jacketing" a Timber Pile with the Cement Gun

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*Lilley and Thurston Co., San Francisco

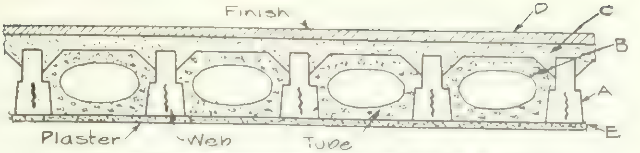
[1] General Cement Products Co., N. Y. C., Lilley and Thurston, San Francisco representatives

[2] American Steel and Wire Co., Chicago

Cost of labor on cement per lin. ft. of coating	238
Cost of rent of gun, cartage, etc., per lin. ft. of coating	.150
Per lin. ft. of pile coated	$ .930

Precast Beams and Concrete Tile in Floor Construction

BY D. DONALDSON



Section Showing Arrangement of "Armored Tubular" Flooring

The precast beam is shown at a; the concrete tile, made in short lengths, approximately 12" or 18" at *b;* the poured concrete covering at *c;* the floor surface at *d;* and the plaster surface at *e*

A system of flooring constructed of reinforced concrete and known as the "armored tubular" floor has been used extensively upon the continent of Europe and in the British Islands. Large areas of this floor have been completed for the government and other owners in high class buildings with success and satisfaction to the architects and engineers concerned. This type of flooring conforms closely in its design to accepted standards of practice in reinforced concrete, this fact being further demonstrated by the successful test results obtained which fully prove the soundness of the principles upon which it is constructed.

Gold medal awards for excellence have been obtained in Germany and Belgium, while the British Fire Prevention Committee, after severe tests, certifies its "Full Protection" qualities, this being the highest qualification and one rarely obtained.

Load tests, conducted also by this eminent body, were successful and satisfactory.

The manufacture of the component parts of this floor is carried out under factory conditions either on the site or at central works and enables a product to be obtained in some ways superior to that produced by casual and often unskilled labor on the job where conditions may be unfavorable to sound construction. The armored tubular floor consists of reinforced concrete joists of a section suitable to the span and load and with reinforcement properly proportioned and embedded in their lower portions. As the section shows, this beam is shouldered to support concrete tile tubes of equal widths, but of varying depths. These tile are factory made, and are readily assembled upon the walls or steel designed for their support, and afford a ready platform for the workmen concerned in the completion of flooring or other building operations. It will be seen that centering has thus been done away with and the floor construction itself arranged to perform this necessary duty, the tile intervening between joists from spacers and by their shape enabling the completing top layer of wet cement to be laid to such thickness as may be required under spans and load conditions.

The top layer concrete, poured wet, flows into and around the top portions of joists exposed between tiles, producing a firm union with the joists, thus completing the structure[1]. In tests to destruction, this floor has never been known to break along the juncture of tile and beams. The mild steel reinforcement commonly used which has its major axis vertical (for reasons of manufacture and handling) is an economic section in rolling and cost. The factory production of joists is most readily performed at a low cost, while the manufacture of floor tile in concrete by hand or power presses in conjunction with the small amount of labor necessary to complete on site combines to make this an economical system.

Spans up to 30′ in the clear have been successfully covered in this construction so that economies can be effected in structural steel.

The hollow slabs afford a ready means for ventilation, drainage pipes or conduits. The system is convenient for cuttings and alterations.

That this system finds its largest and greatly increasing use under the closely guarded State control of building operations in continental countries is sufficient guarantee of its capacity for sound and efficient service.

From an American point of view, further advantages exist in the possibility of advance preparation of floor units, permitting speedy construction, the possible use of flooring as soon as laid down, and from a climatic standpoint, the factory manufacture of essential bearing units with ease of completion and elimination of centering, offer elements of suitability for the American building market.

Cinder Concrete for Residence Wall Construction

In the group of 40 houses recently completed for the D. L. & W. R. R. Co., at Nanticoke, Pa., steam cinders are being used as concrete aggregate. These are graded from the size of fine sand to clinkers 1-in. or so in diameter. No sand is used, and the proportion is 1 part of cement to 7 parts cinders. To this, hydrated lime to the extent of 50% (volume) of cement is added. This makes an extremely light and tough wall, weighing no more than solid wooden blocks. This is waterproofed on the exterior by a paint or by a cement coating, and gives a much better insulation against heat and cold than is possible to obtain with a stone and sand concrete.

The houses at Nanticoke were built by Read and Morrill, N. Y. C., and Mr. Morrill states that in his experience, cinder-concrete is much less subject to shrinkage cracks than is stone or gravel concrete. While cinder-concrete does not develop the strength of stone-concrete, it is amply strong for average construction; for the walls, floors, and partitions of poured houses cinder-concrete is preferable on account of the insulating properties. Furring can be eliminated, and in many of the houses, even the plastering is entirely eliminated, as a smooth surface is left by the steel forms, broken only by a slight pattern formed at the jointing of the plates.

Profit-Sharing in An Architectural Firm

Profit-sharing by employers with their employees received a practical endorsement at a banquet held recently in Philadelphia, at which were gathered all the associates and employees of the New York and Philadelphia offices of the architectural and engineering firm of Ballinger and Perrot. Profit-sharing has been practiced by this firm in the past to the extent of sharing a certain portion of the net profits with the heads of their several departments. This proved so satisfactory that the firm decided to extend the plan to all of its employees, from the highest to the lowest, believing thereby to obtain an increased co-operation and efficiency throughout their entire force. This plan was announced and put into immediate effect at the banquet mentioned. No pretense is made by the firm that the profit-sharing plan is a species of philanthropy, it being their firm belief that fair treatment of the employees is of mutual benefit to employer and employee. This thought has also found expression in numerous industrial buildings designed by this firm in which lighting, sanitation, and healthful conditions have been given foremost consideration.

The average cost for hauling grain from the farm to the station (an average haul of 9½ miles) is $ .054 cts. per 100 lbs., while the average ocean rate between New York and Liverpool is $ .038 cts. per 100 lbs. Our ocean, railroad and steamship rates have steadily decreased in recent years, while our common road rates have remained practically stationary, except in those sections whose roads have been improved with a hard wearing surface. As long as these conditions prevail we cannot expect the price of foodstuffs to go down.—D. E. Curtis, in *The Architect and Engineer.*

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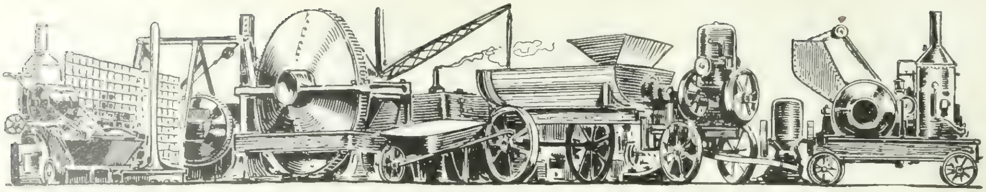
[1] Attention is called to the possibility of surfacing this poured concrete covering and using it as a finish coat.—EDITORS



New Equipment, Methods and Materials

In this department the EDITORS endeavor to keep our subscribers informed upon new tools, methods, machines and materials used in this industry. It is in no sense a department for the benefit of advertisers. To secure attention the thing described must be new to our readers. No matter will be printed simply because an advertiser desires it. Likewise, no matter will be excluded simply because the article described is not advertised in this paper. We aim to keep our readers informed—suggestions for the improvement of this department are solicited.

Handling Concrete in Cold Weather

The accompanying illustrations show the foundation work on the building recently completed for the Mutual Life Insurance Co. at Milwaukee. Most of the material required for these foundations was received in a frozen condition and had to be thawed out before mixing and heated to a temperature sufficient to prevent freezing after the concrete had been poured. This was accomplished by providing a storage bin containing a series of steam coils, in which the material was allowed to remain at least two hrs., reaching usually a temperature of from 50° to 60°. The mixers were also fitted with an attachment on the tank by which a steam jet was introduced into the water, keeping it heated to a high temperature; thus all of the ingredients except the cement were heated when they entered the mixer.

The work progressed night and day, making an unusually severe tax on the machinery, which was in operation almost continually during the period of pouring. The mixers averaged about one batch per min., often working 21 hrs. a day. When going at full capacity the mixers turned out a ½-yd. batch in 47 secs. Three ½-yard Chain Belt[1] miyers were used.

The foundations proper were poured continuously, while the walls above were poured in sections. There was, however, very little delay between the pouring of the different sections of the wall, so that these were practically monolithic.

The concrete used was a 1:3:5 mix-crushed gravel, ¾-in. to 1½-in. A total ture, and the aggregate consisted of of approximately 15,000 bbls. of cement was used and the amount of concrete in the finished foundations amounted to in the neighborhood of 12,000 cu. yds. The work was done by the Hedden Construction Co., N. Y. C.

* * *

Bonding Values of Waterproofing Compounds

In the construction of St. Peter's Cathedral, St. Louis, the bonding power of a waterproof compound was strikingly indicated by an incident occurring in the course of the work. Victor J. Klutho, a St. Louis architect, states that while using "Elaterite"[1] waterproofing on the walls of this cathedral an occurrence took place showing the bonding power of this material. Two coats of the waterproofing were specified to be applied before putting on the plastering, but in one instance a small patch of plastering was applied by one of the men over the first coat. When this was discovered, he was instructed to remove it and, in doing so the adhesive qualities of the waterproofing compound were so great that parts of the brick itself came off with it.

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[1] Chain Belt Co., Milwaukee

[1] Elaterite Paint and Mfg. Co., Des Moines, Ia.

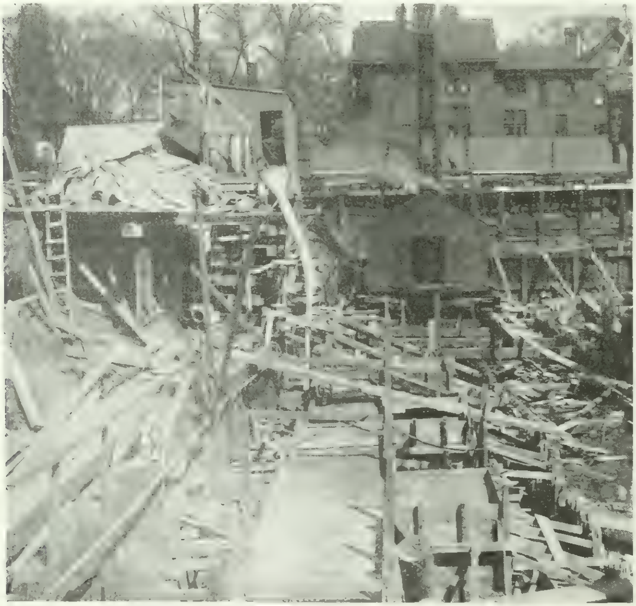


Fig. 1—General View Showing Arrangement of Mixer and Spouts for Placing Concrete in Foundations

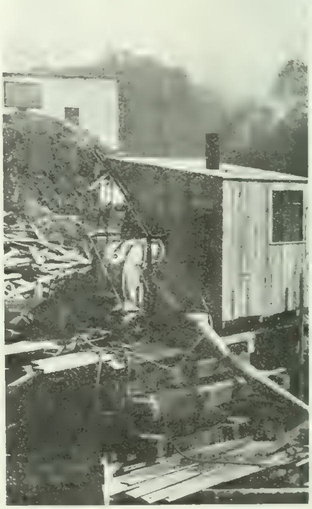


Fig. 2—Detail View Showing the Mouth of the Chute, and the Cribbing Used to Carry Mixer Close to the Building Line

We need a few copies each of No. 1 Vol. 1 Concrete-Cement Age for July, 1912, and of No. 2 Vol. 1, August, 1912, and any reader who is not trying to keep a complete file of the magazine and has copies of these issues to spare, will favor us very much by dropping us a line. We are willing to pay 20c each for a limited number of copies of these issues or will extend a subscription period for two months for each copy. Please write us, however, before sending in the magazines—Concrete-Cement Age.

Owing to enlargements at the Buffington, Ind., plant of the Universal Portland Cement Co., the 1912 output showed the largest increase in production of any of the 12 years of the plant's operation. It touched 10,114,500 bbls., or more than 3,000,000 bbls. more than in 1911. The 1900 production was 32,443 bbls.

A Floor Sleeper Anchor

Engineers and architects have given a good deal of anxious thought to the best methods of holding floor sleepers to a concrete floor. As pointed out in these pages in past issues[1], there is a danger from dry rot when floor sleepers are embedded in wet cinder concrete.

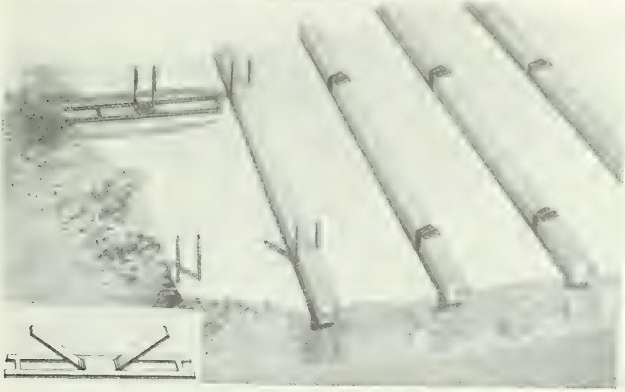
The steel tie shown in the accompanying illustration, which has been developed and put on the market by the Steel Floor Sleeper Anchor Co., Toronto, Ont., is a continuous strip of galvanized iron, 2" wide and punched as shown on 12-in., 16-in., and 24-in., centers. After the concrete for a section of the floor has been placed, the anchor strips are tamped in, at right angles to the position the floor sleepers will occupy.

When the concrete is set, the projecting prongs are bent outward, and flat, so as not to interfere with the workman. The sleepers are placed, brought to a proper level, and the ties bent over and secured. A bundle of shingles, broken into short pieces make handy shims to bring the sleepers to the proper level.

Such an anchor apparently offers many advantages. The weight of the cinder fill is saved altogether. This means something in a high office building.

Where time is a consideration in the completion of the building, the time necessary for the drying out of the moisture in the concrete filler under the old system has been a great source of annoyance to the contractor and the engineer. All too frequently chances were taken along this line in putting in the hardwood floors and interior finish only to find out that there was still sufficient moisture to warp and ruin the interior finish.

At a cost of about $3.00 per 100 lin. ft. the cost of such a steel anchor can readily be estimated, and its economy in comparison with the labor and material cost of a cinder fill, readily figured.



Perspective View and Sketch Showing a Steel Sleeper Anchor

One Mold to Produce Two Different Columns

A new column mold has been put on the market by the Goshen Cement Mold Co. Goshen, Ind. It turns out a round tapered column and the mold is so constructed that part or all of its pieces may be used at one time, with the result that columns of two different kinds and sizes can be made, as shown in Figs. 1 and 2. It will be seen that the column in Fig. 2 is exactly like that in Fig. 1 with the exception that a section is omitted just under the cap. The longer column is 5' high and the shorter one 4' 6". The manufacturers say that two or three columns can be made in one day with one mold. The diameter of the column is 9", the base is 11½" and the cap is 9¾". Using an ordinary mixture of concrete the material required is 5 buckets of sand to 2 buckets of cement for one column.

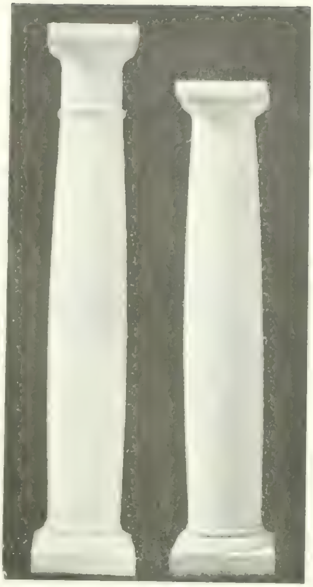


Fig. 1—Fig. 2

Pneumatic Conveyors for Concrete

The concrete "blower" as it is called, shown in the accompanying illustrations, consists of a hopper and drum superimposed over an air chamber through which a current of air is passed. The dry materials, mixed or unmixed, are placed in the receiving hopper, and, when ready, dropped as a batch into the drum by opening the dome-shaped air lock. The bottom of the drum is a flat feed screw, or worm, revolved by an air motor. This controls the rate and amount of concrete material fed. As the screw or worm revolves, it feeds the aggregates into the rapidly moving stream of air. Water is fed into the chamber at the same time. The idea in this machine is to take advantage of the velocity of the air to sweep along the material and not use it in any way as a pusher.

The conveyor described is manufactured by the Concrete Blower Co., N. Y. C., and, the manufacturers state, should replace hoisting engines, buckets, elevator towers, cars and tracks. The economy of such equipment is especially marked in tunnel construction.

The amount of air required depends on the height and distance to which

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[1] [Note in this connection the discussion of consultation Item 160 in past issues of *Cement Age* and *Concrete Engineering*. This question was first discussed by Ira H. Woolson, Cons. Eng., Nat'l. Bd. of Fire Underwriters, N. Y. C., in *Concrete Engineering*, March, 1910. Mr. Woolson pointed out the danger from dry rot in floor sleepers, and cited examples where this had caused expense and inconvenience. · This question—(No. 160—Decay of Floor Sleepers), has been discussed in several issues of the journals cited since that time.—Editors.]

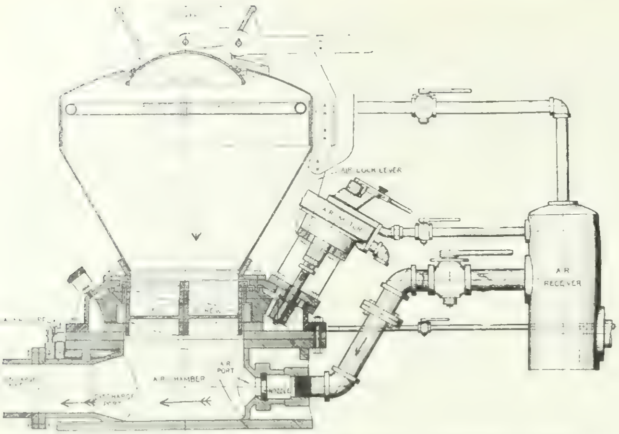


Fig. 1—Diagram Showing the Concrete "Blower" in Longitudinal Section

concrete must be handled. It is planned to build the blowers in five sizes, capacities running from 4 cu. ft. to 40 cu. ft. The manufacturers' specifications state that a pneumatic concrete blower outfit, suitable for placing 100 cu. yds. of concrete in 8 hrs., a distance of 500 ft. from the blower, would consist of a blower of 10 cu. ft. capacity; 500' of 6-in. pipe; necessary bends on a 5-ft. radius; an air compressor, having a capacity of 500 cu. ft. per min. at 60-lbs. pressure, and an air receiver of 200 cu. ft. capacity. With a plant of this description, 100 cu. yds. of concrete can be mixed and conveyed through the discharge pipe a distance of 500 ft. in 8 hrs. The labor required to operate this plant, exclusive of the compressor crew, should consist of four men.

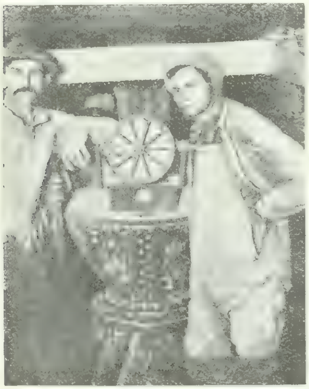


Fig. 2—The Concrete "Blower" Used to Mix and Place Concrete in Side Walls and Invert of a Small Tunnel

* * *

Removal

On and after Mar. 1, the Cinch Expansion Bolt & Engineering Co. will be located at 208 Lafayette St., N. Y. C. Larger quarters are required to take care of the increased business.

A New Stud and Panel Wall Centering

All systems of wall centering which use sheathing and studs practically without exception, have supported the sheathing directly against the studs. The McKay Concrete Form Co., N. Y. C., is putting on the market a wall form presenting some new features. A double stud is used, consisting of the regulation 2-in x 4-in., or 2-in. x 6-in. timber, and a deep steel channel bolted over the face of the timber stud, and slotted along the side. By these slots, the plates are fastened.

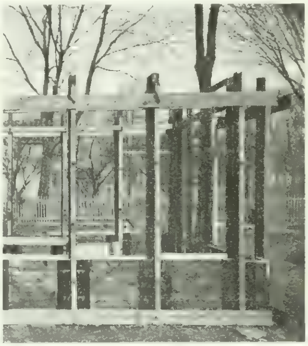


Fig. 1—Wall Centering Using a Double Slotted Stud and Set-in Panels

The plates, or panels, have a wall surface of approximately 21-in. x 36-in. The double studs are placed at the proper distances along the walls, and the panels placed between them, held in position by an ingenious latch which turns down into the slot in the side of the channel stud.

The accompanying illustrations show the essential features of this system. Fig. 1 shows the studs and one course of panels in place. Fig. 2 shows the forms on actual wall work, in which the outside wall owing to the closeness of the side of the excavation, is centered with planks. The system as so developed is a radical departure from accepted forms. The manufacturers are planning to extend the principles of this to floors, tunnels, etc.

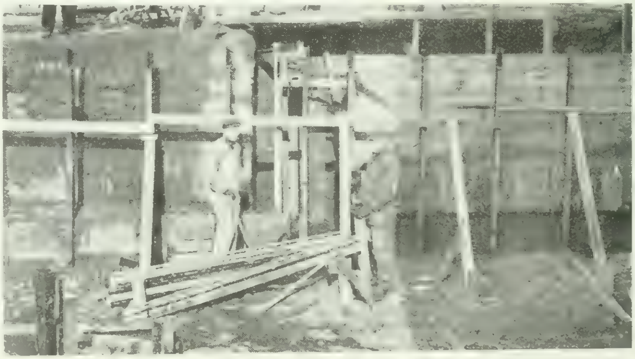
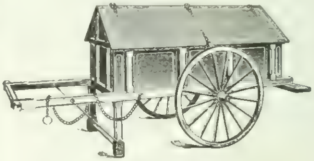


Fig. 2—The McKay Wall Centering In Use On Foundation Work

A New Tool Cart

It would be interesting to know the actual value, in dollars and cents, of the tools lost and stolen the past year. Every contractor employing a crew of men and using spades, shovels, axes, picks and many other and even more valuable tools, knows that his losses each year amount to no small sum—a sum that could be largely saved were five minutes spent each evening by the foreman in seeing to it that all tools are picked up and placed in safe keeping for the night. The Lansing Co., Lansing, Mich., offer an inexpensive tool



The Lansing Tool Cart

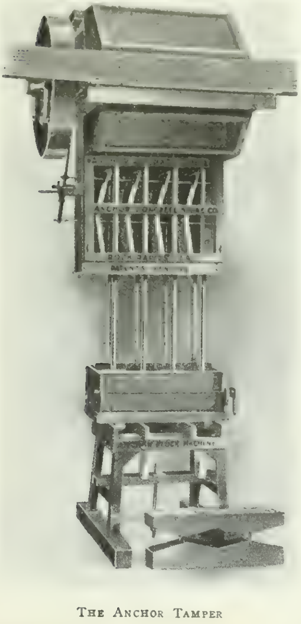
cart that might well be a part of every contractor's outfit. The cart is long enough to accommodate any of the common, long-handlel tools, and capacious enough to hold not only the contractor's own tools, but also those of his carpenters and other special workmen, making it unnecessary for each man to carry his kit home with him every night.

This tool cart is mounted on strong, high wheels and can be moved about from one job to another along with the mixers and other equipment.

* * *

A Tamper For Any Mold Box

The Anchor Concrete Stone Co., Rock Rapids, Ia., is producing a new automatic tamper with which experiments have been made for more than a year, with the idea of putting on the market a tamper which could be adjusted and adapted for use on any mold box of block or brick machine. Numerous difficulties in connection with the production of this tamper have been overcome, one of the chief difficulties in tamper construction being so to provide for easement of the parts as to prevent wrecking and tearing the machine to pieces by the constant heavy blows. It was necessary to arrange the tamper rods so that they would fall in perfect time, in order that the crank arms might raise them with the least possible shock. The crank arms are operated through four heavy springs. Fibre rollers have been used where these rollers come in contact with the lifting guides. With the timing device, the brake, the fibre rollers and the shock absorber on the main drive wheel, the manufacturers believe that they have a tamper which will run for a long time with a minimum chance for breakage. So confident are they of the lasting quality of the parts, that the tamper is put on the market with a guarantee to replace all broken parts for a period of three years. One of these tampers is shown in the accompanying illustration. The construction, of course, varies for the different mold boxes for which it is intended.



The Anchor Tamper

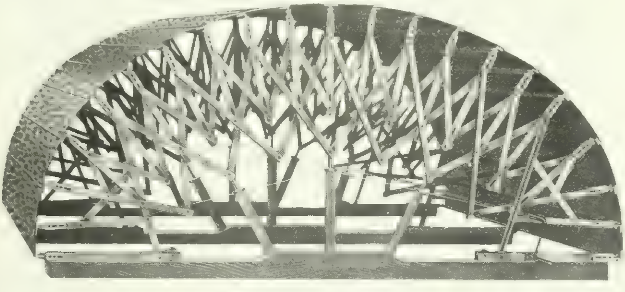
* * *

A New Bridge and Culvert Form

A new type of adjustable bridge and culvert form for arches from 6′ to 12′ is manufactured by the Merillat Culvert Core Co., Winfield, Ia., and its use, so far, has developed low cost. The illustration shows this collapsible form. The height of the arch when fully expanded with this form is 5′ 2″ with proportionate heights for openings of shorter span. The shape of the arch can be changed by raising or lowering the adjustment. After the arches are set up to the desired size, the cover, which makes the form, is placed over them and fastened by means of pins run through the angle irons, which in turn are fastened to the cover itself. When the concrete has hardened the entire form is collapsed simply by removing the jack screws and by turning the crank shown at the right of the illustration. After the form has been collapsed, the sheets forming the cover are removed separately, the heaviest single piece of the form weighing 200 lbs. The outside cover is made of heavy galvanized steel strengthened by heavy angles. The entire form can be set up ready for use in but a few hours.

In connection with the use of Merillat culvert forms, some cost information is supplied by the Board of Supervisors of De Soto county, Miss. A culvert 3′ 6″ in diameter and 25′ long, with wing walls 10′ long 6′ high and 10″ thick at both ends of the culvert, was built at Horn Lake in De Soto county at a cost of $49.80. All the material that went into the consruction of the culver was shipped from Memphis, and the entire job was done in one day by an inexperienced crew. It was figured by the commissioners that a corrugated metal culvert of like size would have cost $90 delivered at the station, so that there would still have been in addition cost for hauling, for wing walls, trench, etc. The cost of the concrete culvert as built is itemized as follows:

48 bags of cement	@ .35	$16.80
10 cubic yards gravel	@ 1.35	13.50
1 foreman 1 day	@ 5.00	5.00
1 team and wagon, 1 day	@ 3.50	3.50
5 laborers, 1 day each	@ 1.50	7.50
Lumber		2.50
Incidental expense, nails, wire, etc.		1.00
Total		$49.80

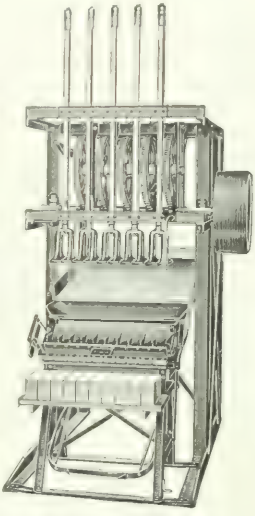


New Adjustable Bridge Form

* * *

Tamper for Brick Machine

A new power tamper operating in connection with his Model B brick machine has been put out by C. S. Wert, Kendallville, Ind. This equipment was in operation at cement shows this winter. With the equipment, the manufacturer says it is possible to manufacture from 16,000 to 20,000 brick in 10 hrs. with four men. The tamper may be operated with a 1 h.p. or 1½ h.p. engine. The line shaft runs 350 r.p.m. and each of the tamper arms strikes the concrete 70 times per min. with 380-lb. blows. With this unit, 10 brick are made in from 9 to 11 sec. The brick machine itself weighs 300 lbs. and the tamper 850 lbs.



Brick Machine and Tamper

Equipment to Make Reinforced Concrete Block

Reinforced concrete block designed to give walls with staggered bearing and with continuous air space, are products of the block equipment manufactured by the Bragstad Concrete Machinery Co., Canton, S. D. The type of block made is shown in Fig. 1 and the equipment is so constructed that the inner or the outer section of the block may be thicker or thinner, as may be required for the particular work in hand. The reinforcement consists of a square loop of No. 6 ga. wire which extends clear around through the two pieces of block, connecting them through the air space. Fig. 2 illustrates corner block made by this system. These block may be made on either one of the two types of equipment manufactured by the Bragstad company. The manufacturer who prefers the dry process block can turn them out on the machine shown in Fig. 3.

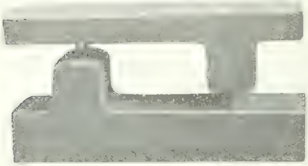


Fig. 1—Reinforced Concrete Block

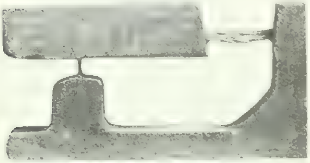


Fig. 2—Corner Block

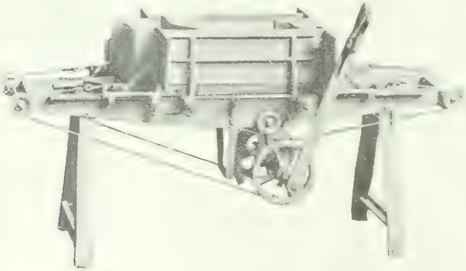


Fig. 3—Block Machine—Dry Process

Fig. 5—House in Canton, S. D., Built of Bragstad Block

Fig. 4—Wet Process Block Molds

However, the equipment most strongly recommended by the Bragstad Co. is for slush process block, which are made in batches of 11 at one time. This equipment is shown in Fig. 4, after the parts have all been put together and the lower layer of the row of blocks has been poured. It may readily be seen from the illustration of the block made, how these are laid up to give continuous air space through the wall. An attractive house built of these block is shown in Fig. 5. The house was built by Chas. Reynolds, Canton, S. D., for himself at a cost of about $4,000. One of the advantages strongly urged by the manufacturers of the equipment is that no furring is required on the interior walls before plastering. The plaster may be put directly on the block without any fear of dampness. The dry process machine can be adjusted to make block of various sizes, lengths and thicknesses, although the standard is 24" long 8" high and 10" thick. In using the wet process equipment block may be made either face up or face down, as the operator desires. This makes it possible to try many different effects in facing. The Bragstad company also makes a tamper to be operated in connection with the block machine and a mixer adapted for continuous or batch mixing. It is said that both mixer and tamper may be operated by one 2-h.p. gasoline engine.

Prepare Stucco and Facing Mixtures

Two things are generally recognized by users of concrete as being essential to its general adoption and its use in artistic and decorative work—a means for making it permanently waterproof and for giving it an attractive and permanent color. There are a number of efficient means of rendering concrete waterproof and several methods of treating the material to be exposed as a surface in such a manner as to render its color pleasing to the eye.

One of the latter consists in coloring the cement used in the mix by incorporating with it a mineral of the desired tint. Silica sand for this purpose is largely and successfully marketed by a number of quarrymen. Silica sand that has been exposed to all weathers for countless years and remains unchanged, may fairly be said to have acquired a lasting reputation for permanency of color. Nature provides a Large deposits of silica sand are located in the state of Wisconsin and the product in various colors has been successfully marketed and used for a number of years.

Under the style of the Verastone Products Co., with offices at 818 S. La Salle St., Chicago, a corporation has been formed to exploit the Wisconsin silica deposits on a large scale, covering the entire country. The manufacturing process includes mixing the sands of various colors, when thoroughly dry, with standard Portland cement. This "waterless mortar" will be bagged and shipped, ready to use in the form of stucco or as facing for block, when the proper percentage of water is added to it and thoroughly mixed with it.

The company's plan for marketing its product is co-operative. Its stock has been placed on the market and stockholders of record are to be given a discount on purchases until the amount of the discounts earned equals the amount of the original paid-up subscription. The obvious purpose of this plan of stock selling and product marketing is to make it to the advantage of stockholders to buy and to make it of advantage to buyers to be stockholders. The originators of the company are no strangers to the manufacturing and the merchandising field.

A tract comprising 262 acres of silica deposits, located about 150 miles from Chicago, belongs to the company. For some time past the material has been used in colored plasters for interior and for exterior walls, for mortar, floors and manufactured marble. The available supply is estimated at 20,000,000 tons.

Fleming and H'Doubler have been named as fiscal agents for the company, to finance the proposition and sell the stock.

Concrete-Cement Age

Vol. II APRIL, 1913 No. 4

Editorials

THE ESSENTIALS in concrete design from an architectural point of view are: a material with a surface free from cracking, a design interpretive of and appropriate to the material, and an harmonious surface finish.

* * *

MUCH INTEREST is being directed to the possible economy and efficiency in handling cement in bulk shipments. The objection has been brought forward that bulk shipments of cement, by not providing a definite unit of measurement, offer the possibility and, in a way, the opportunity of "skinning" the job by not using enough cement. This is poor argument. The man who wants to "skin" will find a way to do it, and means and methods should be developed by which the honest builder can get accurately whatever proportions of cement he desires. Bulk shipment of cement does not involve ethics.

* * *

DISCUSSING the problem of reinforced concrete design, an English authority states that the principal weaknesses of modern architecture are an insufficient grasp of scientific construction and a proneness to follow mere appearance and fashion. In this country the collaboration of the engineer and the architect, working either as one firm or as separate firms, has tended to overcome the first difficulty; reinforced concrete construction, bringing into the field a new and a dominant material, has called for new and often radical interpretation and use. The salient successes in concrete design are those in which the architect has used concrete as concrete, and has not followed time-worn precedent.

* * *

THE FROWN, proceeding from a peculiar "ethical" viewpoint, and occasioned by the use of concrete as an architectural unit in place of stone—"a substitute recommended by its cheapness"—is not seen now with such frequency. It is really a great misfortune that concrete is so economical. If it were as expensive and as inferior a material for some uses as is some natural stone, it might fare better in specifications written by those few who still cling to the superstition that the unfinished product of Nature's workshop is necessarily the best. The fact of the matter is that Nature provided the materials for a continuation of her processes and in employing man to execute them has merely extended her activities. These thoughts are suggested by Julius Carstanjen's paper elsewhere in this issue describing the early decay of stone statuary and columns and their restoration with concrete which was found to be a better material in resisting the spalling influence of moisture absorbed and then frozen.

* * *

IN THE BEST developments of reinforced concrete work the man in responsible charge in the field should have an intimate, a real working knowledge of the material with which he deals. Remember that concrete construction involves manufacturing as well as erection problems. Heretofore, in all the building trades, the material has been received in the field as a finished unit. The steel erector receives beams and girders with the neutral axis, radius of gyration, etc., actually pre-determined. Over these factors he has no influence. It is for him to assemble the units, as they are brought to him. Brick and tile are factory made, and stone masonry comes to the field ready to shape and erect.

In concrete, however, the situation is different, and, as stated above, it is a problem of manufacture, as well as of erection. Remember that in concrete construction the man bending and placing the steel rods is actually determining with his own hand the neutral axis of that beam, the man behind the mixer is, in a way, determining the actual structural value of the concrete, and the man spading on the floor determines, to a certain extent, by the way in which he handles the concrete, the flange depth and T-beam efficiency. The superintendent in charge of the work and responsible for it works with these men and over them. For the successful execution of that work we must give the superintendent every means and every encouragement making for a better understanding of it. Toward this end we have from time to time urged that means and methods be developed whereby the superintendent can have an intimate first-hand knowledge of his material. He should be encouraged to investigate the physical qualities of his materials, the percentages of voids in his aggregates, so that he can combine them to make the best possible concrete.

Within the past year we have from time to time published descriptions of the "control beam" developed by Dr. Von Emperger, Vienna, and other engineers. The use of this test beam means that at the time any section of the concrete structure is cast a small concrete beam is cast of the same concrete. These are usually over-reinforced and are broken at certain intervals to determine the value of concrete in compression. Abroad they are used mainly to determine when it is safe to pull forms, and have been of special use in cold weather. American engineers have not received the test beam very cordially or over enthusiastically, and in this apparent lack of appreciation our American engineers seem to have overlooked one of the most important factors involved in such testing methods, and that is the psychological effect on the superintendent and the men around him, resulting from an exact knowledge of the actual value of the concretes poured under their direction. More emphasis could well be placed upon this factor, and it is to be hoped that the future developments in testing concrete will consider more carefully the extent to which test beam methods are used.

* * *

Shipment of Cement in Bulk

Much interest has been centered throughout the past year on experiments conducted to determine the efficiency and economy of shipping cement in bulk. Up to the present time results have shown positively that bulk cement can be used to advantage in certain classes of work and that when used under conditions that do not require teaming or other rehandling, it is economical and advantageous in every way. The experiments that have been made up to date have been rather crudely conducted, and it will probably take several years of rather extensive use to evolve the best methods of handling material in this form and to decide the limit to which it is of advantage to extend its use. A correspondent brought up the point in a former issue of CONCRETE-CEMENT AGE that the unit container for cement should be kept so that the cement could be handled in proper quantities into the batch mixer.

This appears to have a direct bearing on the relation of bulk shipments of cement to the use of continuous mixers. Continuous mixers, as is well known, are usually equipped with mechanical proportioning hoppers, and the continuous mixer manufacturers might, it seems, meet the development of bulk shipments of cement more than half way by equipping their mixers to handle bulk cement economically. It would seem to be a logical first impression that bulk cement might work to the advantage of self-proportioning, continuous mixers.

We were somewhat surprised, therefore, to hear a recent opinion from a prominent continuous mixer manufacturer to the effect that sacked cement is more practical, especially for mixers of the continuous type. This manufacturer cites as a practical objection to bulk cement the fact that in a great majority of cases the continuous machine has to make frequent changes, that is to say, it must be moved around to follow the work. This, of course, would make it necessary to have the cement in such form that it could be measured and distributed according to the quantity required in each part of the work, but in urging this objection, the manufacturer has overlooked the point that the advocates of bulk cement are at present recommending that its use be limited to factories devoted to the manufacture of concrete products and to large construction jobs adjacent to railroad tracks, where the cement is handled direct from the car to the mixer.

As a matter of fact, we can see no reason why bulk cement should not be used with either a continuous or a batch mixer where other conditions are favorable. Practically all the factories that are now using bulk cement employ mixers of the continuous type, and as long as the mixer itself is mechanically efficient we cannot see how it makes any difference whether the cement hopper is kept filled by emptying sacks of cement into it, by shoveling the cement in from an adjacent pile or bin, or by running it in through a pipe. Both the large construction jobs that have recently been done with bulk cement employed batch mixers, and in both these cases the cement was measured in the wheelbarrows that were used to unload the cars in exactly the same way that the sand and the stone were measured, and no losses or bad results were observable in either case.

It is axiomatic that anything which tends to lower the cost of concrete work will have the effect of increasing the amount of concrete work that is done. Anything that increases and develops the scope of concrete will be to the advantage of everybody connected with the industry. Therefore, we would respectfully suggest that mixer manufacturers, as well as cement manufacturers, while recognizing that there are conditions where the use of bulk cement is not to be recommended should yet devote their energies to the development of means of handling bulk cement to the best advantage where conditions permit of its being used, to the end that the entire cement industry may profit thereby.

* * *

A Failure in Engineering Design

Photographs and notes showing the failure of a theatre roof were recently received from a Chicago correspondent. The roof construction here was a 12-in flat tile arch, supported on 12-in. I-beams. The roof carried a cinder fill to develop proper drainage facilities.

The roof fell one evening within a few minutes after the theatre had been emptied of its audience. The beams seemed to have simply sagged and fallen, and the photographs show in detail the mass of twisted I-beams, shattered tile, cinder fill, tar and gravel roofing crushed down into the seats of the balcony and the pit.

What would have been a most horrible catastrophe was avoided only by the happy chance that the theatre was empty. It was very probable that the vibration of the building, developed as the crowd emptied, proved the final straw that brought down the roof. Attention has been directed to the fact that this roof construction was altogether too light for the service it had to perform; I-beams of too light section were used. There appears to be no question as to the average good quality of the material and the building methods used, and it hardly seems proper to cite this as a failure of structural steel and tile floor construction. It is mentioned, not as a hollow tile and steel failure, but as a failure in design. If failure involving concrete could be studied with less prejudice and a more appreciative comprehension of the problem as a whole, it would be to the advantage of modern building construction.

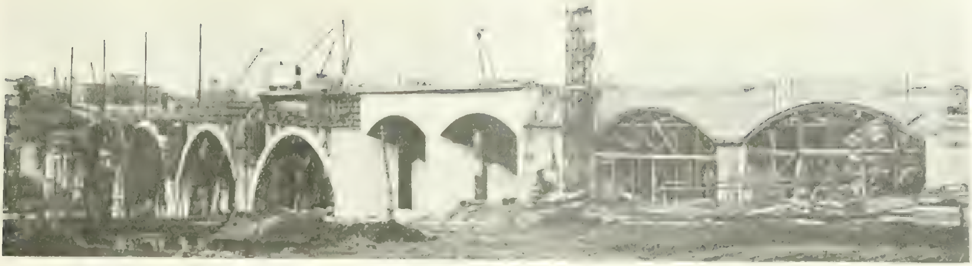


Fig. 1—General View of the South 8th Street Viaduct at Allentown, Pa.

At the extreme left are shown the piers for the 120-ft. arches, the arch centering in place, and three of the arches poured. The stiff-leg traveling derrick is erected over the first completed long arch. At the right are shown the 52-ft. span approach arches with the portable mixing plant and tower in the central part of the illustration

A Reinforced Concrete Viaduct for Heavy Service

Uniform Spans, Steel Centers, Modern Mixing Plants for Construction Efficiency

BY B. H. DAVIS*

The construction of an immense reinforced concrete viaduct in the city of Allentown, Pa., for the heaviest kind of urban and interurban traffic is but another demonstration of the growing favor with which reinforced concrete as a building material is being looked upon by large corporations, far-seeing business men, and public spirited citizens desirous of securing the best, most permanent and in reality the least expensive and at the same time the most pleasing type of construction possible for their large and important public and private improvements.

The South Eighth Street viaduct as it is called is attracting attention among engineers, financiers, public officials and traction companies more on account of the method of its financing, which was undertaken entirely by private capital, as a toll bridge than on account of its extreme size and prominent location, which will make it when completed the most imposing structure of its kind in a section of the country that already boasts some of the finest concrete structures in the world.

Location

The viaduct is located in the heart of the most celebrated Portland cement producing district of this country and connects two wards of the city of Allentown, affording a splendid high level highway and electric railway route of travel from Allentown toward Philadelphia. For this heavy suburban traffic the viaduct was especially designed.

The Lehigh Valley Transit Co. has recently established a fast express service between Allentown and Philadelphia which already demands the running of cars *en train,* fully justifying the assumptions of loading used in the calculations. Watson's specifications for Class E Bridges[1] were followed both as to assumed loading and allowable working stresses in steel and concrete.

The viaduct inclusive of approaches is 2,600′ long by 46′ wide, and is about 125 ft. in height from top of rail to bed of stream of the little Lehigh River which it crosses. It also spans a number of city streets and the tracks of the Barber branch of L. V. R. R. and the graded road bed of the Allentown and Auburn R. R.

The roadway which is 32′ in width between curbs and the two sidewalks each 7′ in width from curb to outside of balustrade, are carried by the two abutments and 16 intermediate piers supporting nine arch spans of 120′ each, and eight arched girders each of 52′ 6″ span.

There is a descending grade of 1.8% on the roadway from the north abutment southward, which by means of a 400-ft. parabolic vertical curve is reduced to a level at the south abutment, there connecting with the 2.6% ascending grade of the south approach.

The 120-ft. spans are each composed of two approximately semi-circular arch rings 4′x8′ in crown section, and 26′ on centers, surmounted by nine spandrel arches and supporting bench walls which by means of 18-ft. semi-circular arches transverse to the axis of the bridge connect the two ribs of each span and furnish direct support for the floor slab which is heavily reinforced in longitudinal direction. The sidewalk slabs overhang the parapet walls 5′ on the long span portion of the work.

Each of the short spans consists of four longitudinal reinforced concrete girders of arched form, as shown in the accompanying illustrations.

The floor slab over these 52-ft. 6-in. girder spans was designed as a part of the compression flange of the T-section girders and is therefore heavily reinforced at right angles to the axis of the bridge. The sidewalks and balustrades overhang the faces of the short span construction 2′ only.

The piers supporting the main arches are solid monoliths of concrete carried from bedrock to the skewbacks of the arch ribs. These monoliths are arranged in pairs 18′ apart laterally for the support of the twin arch ribs of 120-ft. spans. Rock was found at depth ranging from 5′ to 15′ below the surface of the ground in all cases.

The piers and abutments supporting the 52-ft. 6-in. girder spans are little more than hollow boxes having 3-ft. walls in the longitudinal direction carried down to rock and connected in pairs transversely by curtain walls 1′ 6″ in thickness extending slightly below ground line properly to brace the slender piers and give their combination a more massive appearance.

Tranverse arches, 1′ 6″ thick and of 10-ft. span are sprung between each pair of connected piers thus tying together the two halves of each small pier in the same manner that the piers of the longer spans are connected. The piers thus form an open avenue from 10′ to 18′ in width along the center line of the structure from abutment to abutment. This is well illustrated in Fig. 14.

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*Cons. engr. Whitehall Bldg., N. Y. C.

[1] This refers to "General Specifications for Concrete Bridges" by Wilbur J. Watson, cons. eng., Cleveland. Class E bridges are city highway bridges carrying electric railway tracks. The specified load is as follows:

"*Class E Bridges* will be designed for a concentrated live load of 24 tons (48,000 lbs.), on two axles, ten (10) foot centers and five (5) ft. ga., assumed to occupy a width of (10 feet; and a uniformly distributed load of one hundred twenty-five (125) lbs. per sq. ft. on all roadways and footwalks. The street railway tracks will be assumed to carry the load specified for Class D Bridges"

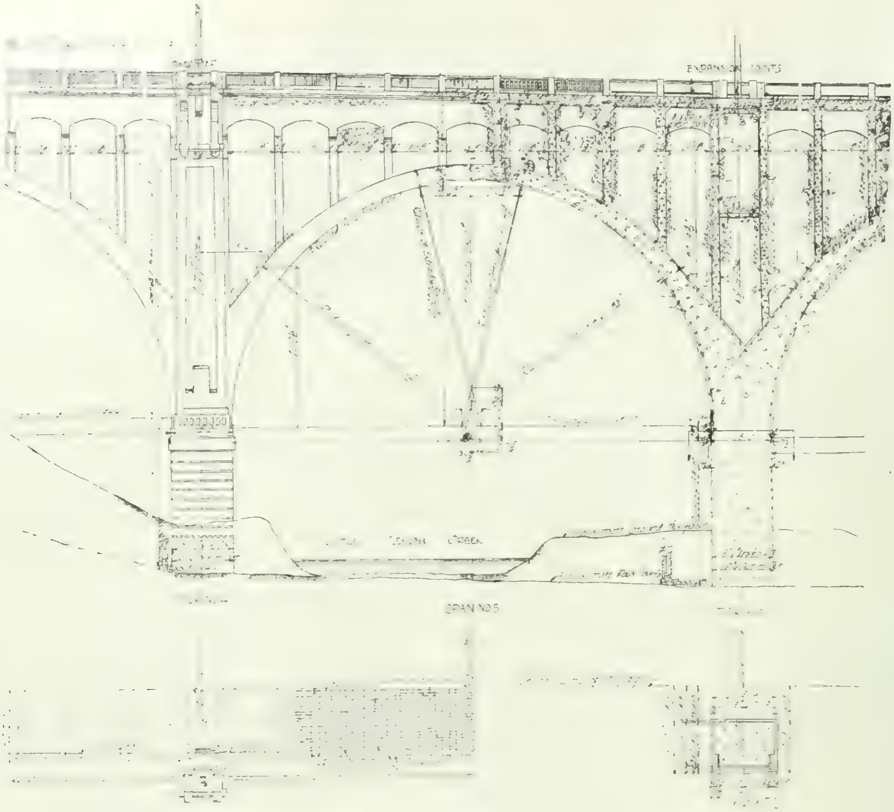

Fig. 2—Elevation of Span No. 5, One of the 120-ft. Arches on the Allentown Bridge

Construction Details

The contractor's plant and equipment and the method adopted of executing the work are perhaps the most interesting features of the undertaking from an engineering standpoint.

A strong standard gauge railway trestle (of pile and frame bent construction) was first built along the center line of the structure for the full length of the long span portion of the work. Two large locomotive cranes (one 35-ton McMyler Interstate,[2] and one 10-ton Am. H. & D.[3]) were operated upon this trestle first to excavate the pier foundations on either side by means of clam-shell buckets suspended from their booms and later were used in erecting forms and placing concrete in them. The immense size and capacity of these cranes made it possible to place concrete in pier forms far above the springing lines of the arches to elevations from which the voussoir construction of the arch rings began without the erection of a single derrick except for unloading of material.

A lighter industrial railway trestle was constructed along the east side of the viaduct and all excavated material as well as form lumber and other material of construction were transported along the bridge site on flat cars of 3-ft. gauge drawn by 12-ton Baldwin[4] locomotives.

Pending the construction of the main trestle and its auxiliary industrial railway, the foundations for a number of the piers of the approach spans were excavated by hand labor and were then concreted to the ground level by means of small portable mixers moved from pier to pier as the excavation for each was completed.

The cement, sand and stone were delivered by teams at this stage of the work. As soon as satisfactory siding facilities were provided, a large central mixing plant was erected with immense storage hoppers feeding by

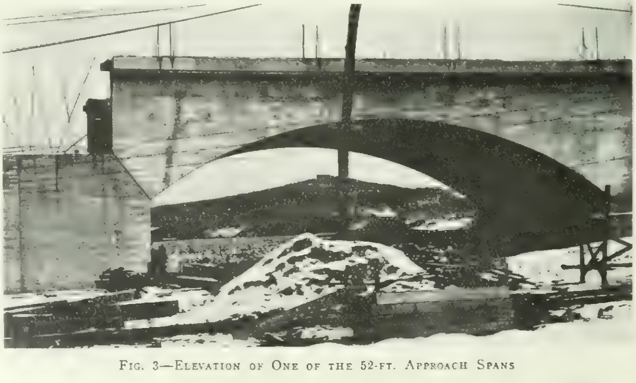

Fig. 3—Elevation of One of the 52-ft. Approach Spans

gravity into the charging hoppers of a 2-cu. yd. mixer.

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[2] The McMyler Interstate Co., Cleveland.

[3] American Hoist and Derrick Co., St. Paul, Minn.

[4] Baldwin Locomotive Wks., Philadelphia

At about the middle of the viaduct a branch of the Lehigh Valley R. R. is crossed very nearly at right angles to its center line, making possible two very convenient spur sidings to the bridge site. One spur runs to the north along the east side of the viaduct and the other runs south along the west side of the structure and parallel with it.

The north siding passes along the side of the cement shed (of 3000-bbl. capacity) and directly beneath the 80-ft. boom of a 10-ton stiff leg derrick which operates a 2½-cu. yd. Hayward[5] clam-shell bucket. Land and stone are unloaded from the cars directly into the storage hoppers or are unloaded and stored in large piles by means of this derrick and clam-shell arrangement Coal is also unloaded from cars in the same manner.

Cement is unloaded by hand from cars alongside the storage shed and the stored material is elevated to the mixing hoppers by means of a belt conveyor.[6]

The southern siding has such a heavy grade, except in the material storage yard near the contractor's saw-mill[7] and machine shop, that it must be operated by a hoisting engine and cable.

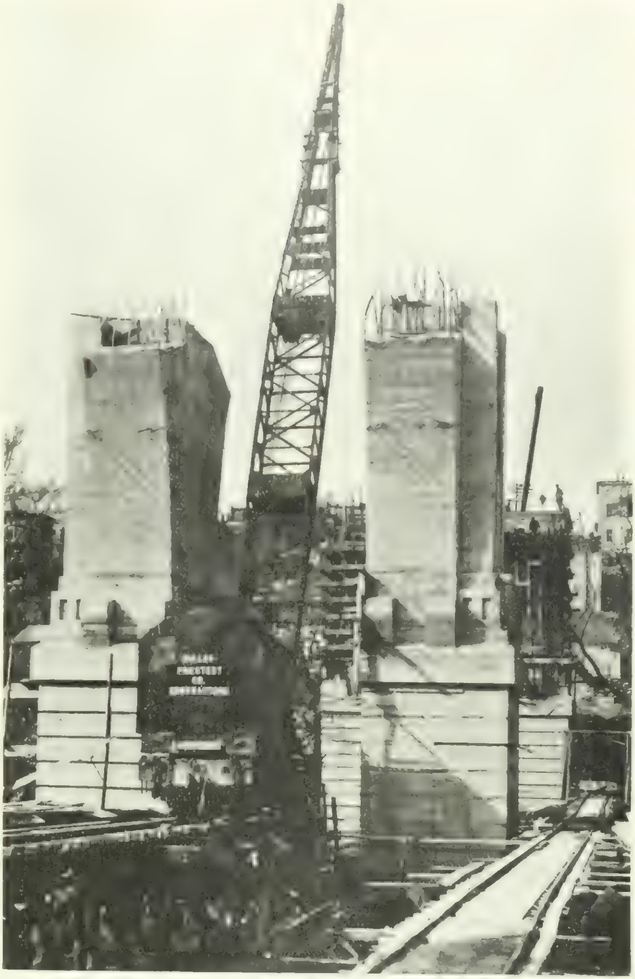

FIG. 4—CONSTRUCTING THE PIERS FOR THE LONG SPAN ARCHES

The locomotive crane is located on the track which was built down the axis of the bridge. The lugs on which the struts for the steel centers are to rest are shown on the faces of the two piers. The bolts which are to hold the struts in place are shown projecting from the faces of the piers. The industrial track is shown at the right with a locomotive in the background

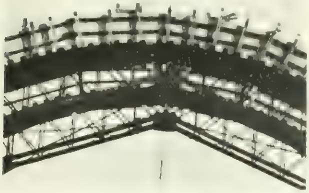

FIG 6—DETAIL OF THE STEEL CENTERING AND AND FORM WORK AT THE CROWN OF ONE OF THE 120 FT. ARCH SPANS

This shows clearly the timber centering used, the double studs held together by bolts and the ends of the 4-in. x 12-in. lagging

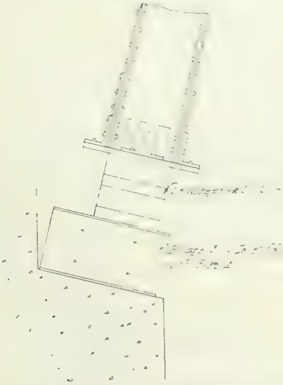

FIG. 7—DETAIL OF THE RELIEVING WEDGES USED TO SUPPORT THE STEEL STRUTS

After the completion of all piers up to the skewbacks of the arches and supports for the girders, a special mixing plant consisting of a No. 3 "Chain Belt"[8] mixer with tip bucket and 30-ft. wooden tower was installed for the construction of the approach girders and floor slabs.

A large derrick with an 80-ft. boom mounted on a steel tower was then erected over each pair of piers of the 120-ft. spans. By means of these the steel centers were erected, lagging and sections of forms elevated into position, and the concrete placed in the arch rings, bench walls and a part of the floor system. The concrete was delivered to these derricks from the central mixing plant in 2-cu. yd. bottom dump buckets on flat cars drawn by the small locomotives.

Running the Arch Ring: The concrete of the arch rings which was of a 1:2:4, mixture was paced in alternate voussoirs of large block and small key sections. The large voussoir blocks were placed in pairs symmetrically distributed over the steel centering so that no distortion might take place and all voussoir blocks of a given arch ring were allowed to set seven days before the connecting keys were poured. By this block and key method of construction it seems evident that practically all the internal stresses set up in arch construction due to shrinkage and deflection of centering under loading of wet concrete are eliminated, for when the steel centers were lowered by means of their wedges and

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[5] The Hayward Co., N. Y. C.

[6] Webster Mfg. Co., Tiffin, O.

[7] The band saws were made by the Amer. Saw-Mill Mach. Co., Hackettstown, N. J.

[8] The Chain Belt Co., Milwaukee

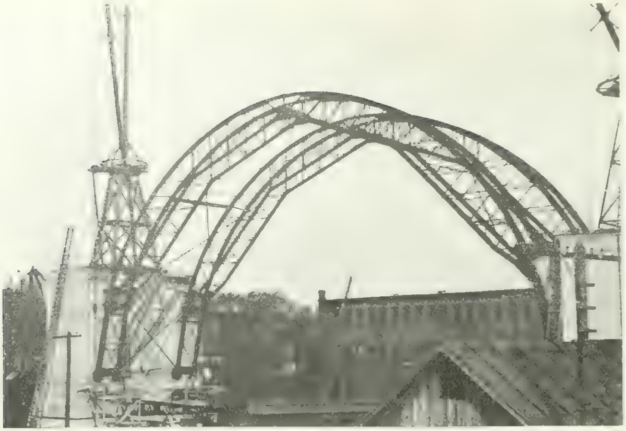

Fig. 5—Erecting the Steel Arch Centers

The arch center proper rests on the braced struts which are carried by the lugs on the faces of the piers shown in Fig. 4. An erecting tower is built supported on a frame resting on each of the piers

jacks, 28 days after concreting the key sections, the crown deflections were so slight as to be hardly measurable and certainly of no consequence. ed to make possible an economy in the

Spans of but two sizes of uniform lengths and rises were purposely selected to make possible an economy in the centering required. For the eight spans of 52′ 6″ and 9-ft. rise four complete sets of wooden centers were required, each center thus being used twice. Considerable difficulty was at first experienced in supporting these wooden centers on spread footings without settlement but later this difficulty was overcome.

The girder spans were concreted as monoliths continuous over at least one intermediate pier, thus necessitating especially rigid centering supports and at times requiring night work for their completion.

Steel Centering. The nine long spans consisting of 18 arch rings each of 120-ft. span and 62-ft. rise required but three full sets of steel centers[9] for their construction, each set thus being used three times in the building of the nine long span arches.

For the support of the steel centering, special brackets of plain concrete were formed on the piers at the spring lines of the arches. These lugs or brackets are later to be tooled off and rubbed smooth, leaving the pier and the belting courses as shown on plans.

In order that no delay might be experienced in striking and moving forward the centering used in the construction of the first three long spans the contractor at his own expense slightly widened the footings of the third and the sixth large pier to make them act as abutments while subject to unbalanced loadings during construction.

It should be noted that each of the long span arch rings was supported on two steel arch trusses spaced 6 ft. center to center, rigidly cross-braced

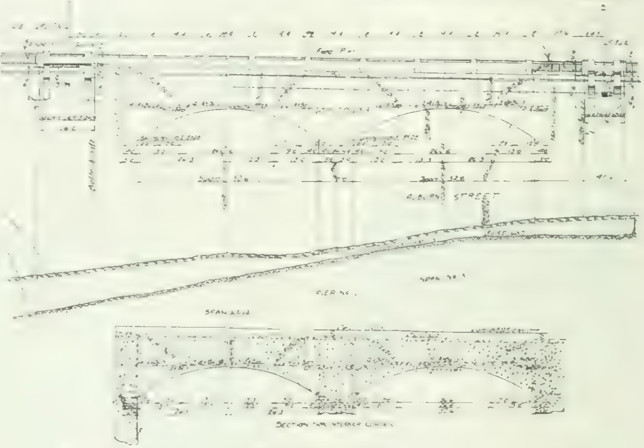

Fig. 8—Elevation of Spans Nos. 12 and 13, Two of the Approach Arches

These are the arches shown completed in the central part of Fig. 1

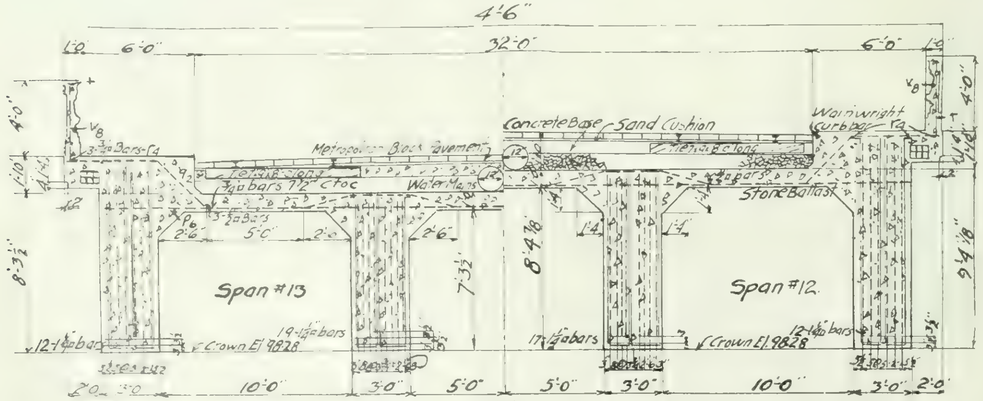

Fig. 9—Section of the Approach Girder Span

This consists essentially of four T-beams. A conduit for lighting wires is shown adjacent to the balustrade. Note the section of the balustrade used together and in effect hinged at crown and skewbacks. These steel arch centers were delivered in such shape as to require very little field fabrication except as to cross-bracing and were erected by the contractor in units as shown by illustration.

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[9] Blaw Steel Construction Co., Pittsburgh

At their crowns the steel ribs were rigidly bolted together through a narrow ⅜-in. bearing plate separating their lower chords while their upper chords were loosely bolted through slotted holes in a top cover plate admitting of a slight hinge motion about the lower chord connection, but not allowing of lateral displacement or motion.

Cast steel wedges transferred the load from the supporting steel columns to the piers and jack-screws provided to facilitate the adjustment of the bearing wedges in erecting as well as striking the arch centers.

The lagging used was 4"x12" yellow pine of first quality, spanning the 6-ft. opening between steel ribs without intermediate support.

The reinforcement of the arch rings consists of 1-in. sq. corrugated bars[10] 1' 6" center to center and 3" from intrados and extrados, passed continuously through blocks and keys alike and simply lapped by corresponding bars projecting from the skewbacks.

After the completion of the arch rings and the portion of the bench walls up to the springing lines of the 18-ft. transverse arches connecting the halves of the structure, the centers were lowered and as much of the connecting floor system and cantilever sidewalks were constructed as was possible or convenient with the derricks mounted over the piers.

A traveling derrick was then constructed on the completed portion of the bridge deck and the derricks and their towers were removed and all remaining gaps in the construction over the piers and adjacent to them were then filled in by the traveler which moved along the structure as succeeding spans were completed.

Finish: A smooth float finish was given to all sidewalk areas which were carefully protected against freezing by tarpaulins and salamanders, as were all other portions of the work subject to possible freezing. Live steam was used when necessary to heat the ingredients and keep the concrete at a temperature of 60° before and after mixing and until such time as it had sufficiently hardened. Curbs were protected by Wainright curb bars[11] cut at all expansion joints which were provided over alternate piers.

The balusters of railings are being cast separately and will be properly embedded in the bases and top rails of the balustrades when they are poured.

All balustrade posts and railings together with the large combination lamp posts[12], which also support the over-

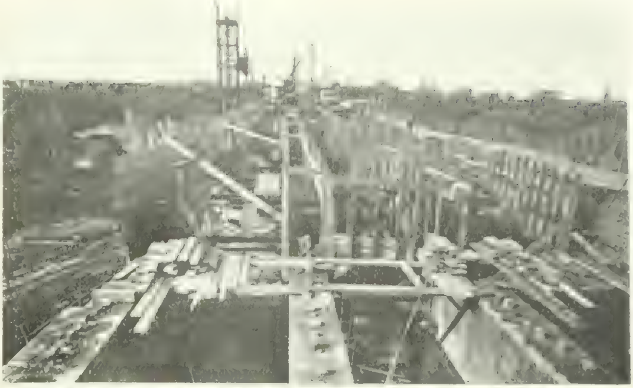

Fig. 10—Detailed View of the Construction of the Hollow Approach Piers

In the foreground is shown the use of large rocks to develop mechanical bond. In front of this is shown the timber centering for the four 52-ft. arch girders as shown in Figs. 8 and 9. A finished section of the structure is shown in the background adjacent to the mixing tower. This is the mixing tower shown in the central portion of Fig. 1. It is interesting to compare Figs. 1 and 10. They are taken at the same time and Fig. 10 is an axial view of the portion of the work shown at the right of Fig. 1.

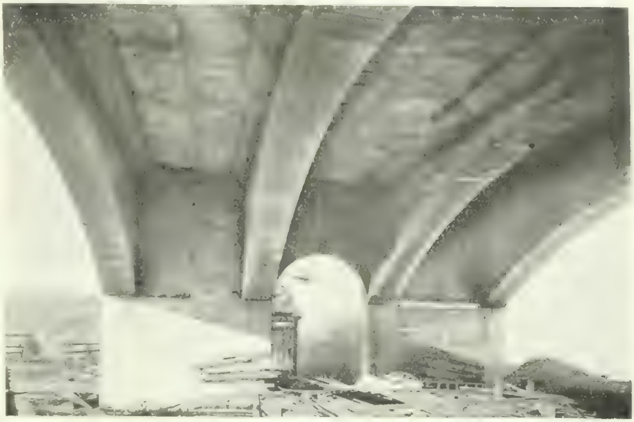

Fig. 11—A Completed Approach Span From Below

This shows plainly the four T-girders of the box piers

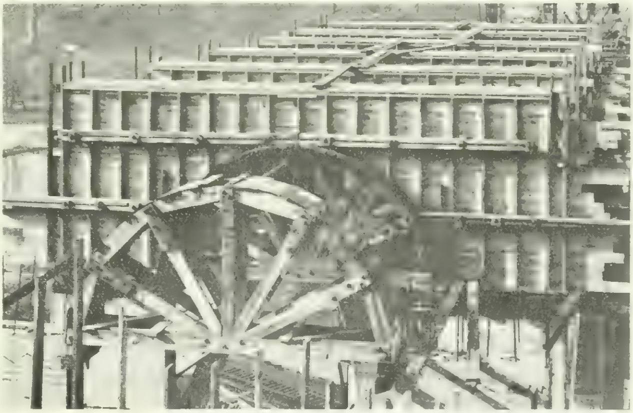

Fig. 13—A Detailed View of the Spandrel Pier and Arch Construction

This shows in detail the centering for the spandrel arches. It is interesting here to note the use of the doubled horizontal stringers

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[10] Corrugated Bar Co., Buffalo.

[11] Steel Protected Concrete Co., Philadelphia

[12] The illuminating equipment will be furnished by the General Electric Co., Schenectady, N. Y., the ornamental iron work by the J. L. Mott Iron Works Co.

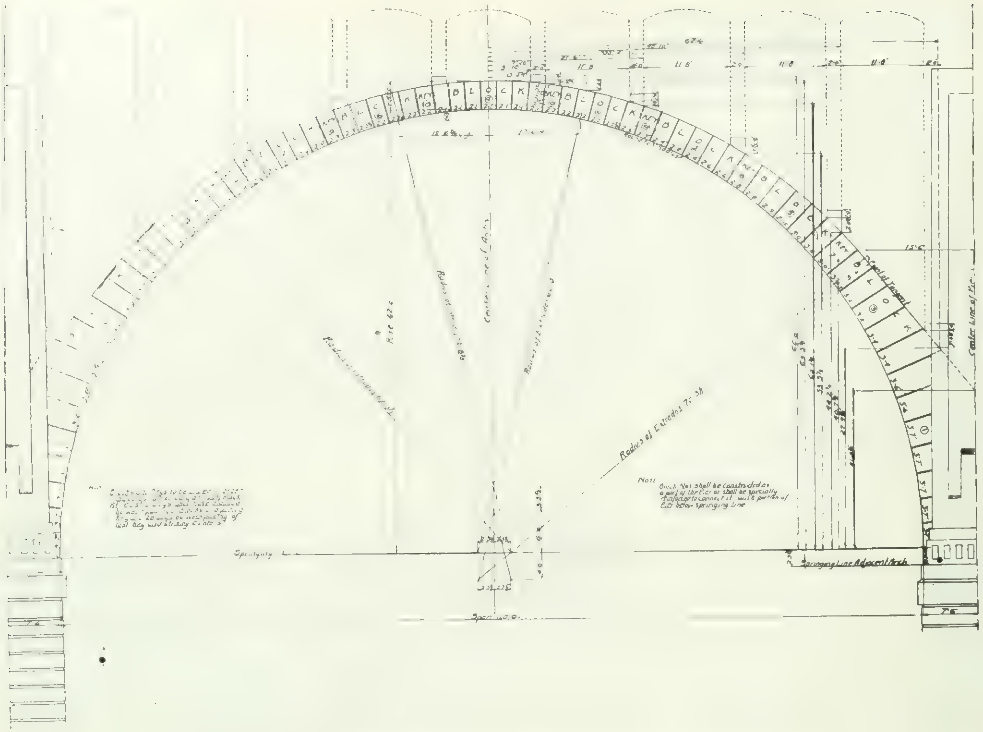

Fig. 12—Elevation of a Typical 120-ft. Arch Showing the Procedure in Pouring Voussoirs

head trolley wires are made of a special granolithic concrete which is to be bush-hammered[13] or tool dressed to bring out and properly expose the selected aggregate of which they are made. A portable pneumatic plant[14] is being installed for this work, though all other exposed surfaces receive only a carborundum[15] rubbed finish.

The cross arms and arc lamp fixtures for lighting the structure are of bronze, as are also the connection details for supporting the over-head trolley wires.

The floor slab over the entire structure is to be waterproofed with a 4-ply membrane of first quality Neponset "Water-Dyke"[16] felt and compound with special details and heavily reinforced membranes at all construction and expansion joints.

Ample provision has been made on both sides of the structure for conduits which are of terra cotta and embedded in the sidewalk slabs with manhole connections at each lamp post.

The roadbed and track construction of the Lehigh Valley Transit Co. is to be laid in a concrete base which is extended laterally completely to cover and protect the waterproofing membrane.

A metropolitan block pavement is to be laid over the whole roadway area from curb to curb with suitable catch-basins placed at regular intervals to conduct drainage water through embedded vertical terra cotta conduits to the ground.

All piers, abutments, bench walls, and transverse arches were constructed of 1:3:5 concrete. Crushed rock sand and broken stone passing a 2½-in. ring were used in this concrete.

All reinforced concrete slabs, girders and main arch rings were made of 1:2:4 concrete, the broken stone passing a 1-in. ring for these portions of the work.

The use of cyclopean concrete was permitted in the larger masses of the main piers, but the contractors did not avail themselves of the privilege except in a very few instances.

Bids for the erection of the viaduct were received by the Allentown Bridge Co., a subsidiary company of the Lehigh Valley Transit Co.,, June 25, 1912, and the contract was awarded to the MacArthur Bros. Co., N. Y. C., for $306,000, exclusive of the cement which was furnished by the owners. Approximately 40,000 bbls. of cement[17] have been required.

The contract calls for the completion of the structure ready for operation by Nov. 1, 1913, which allows 400 working days as the total time for the completion of the work. At the present rate of progress, however, the viaduct will in all probability be thrown open to traffic at a considerably earlier date than that anticipated by the terms of the contract.

The contractors are represented in the field by F. C. Cullen, of the contracting firm of Cullen & Freistedt, Chicago. The engineering of the structure is in charge of W. W. Wysor, ch. eng. of the Allentown Bridge Co. and of the Lehigh Valley Transit Co., assisted by the writer, who, as consulting engineer, prepared the plans and specifications of the structure for him and for R. P. Stevens, president of both companies.

Further Construction Details

At the suggestion of Mr. Davis, we have received from E. K. Cortright, res. engr. on the work, the following notes covering a little more in detail the mixing plants used and the steel centering:

Mixing Plant: The topography of the bridge site made it advisable to adopt three separate mixing plants. For all concrete work on the nine 120-

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[13] Chicago Pneumatic Tool Co., Chicago

[14] Ingersoll-Rand Co., N. Y. C.

[15] Carborundum Co., Niagara Falls, N. Y.

[16] F. W. Bird and Son, E. Walpole, Mass.

[17] Lehigh Portland Cement Co., Allentown, Pa.

ft. spans, the flat nature of the site and the proximity of the Barber Branch of the Lehigh Valley R. R. afforded an excellent opportunity for the location of a central mixing plant, and all concrete was delivered by means of an industrial railway running parallel and immediately adjacent to the east side of the piers. The concrete on leaving the mixer in 2 cu. yd. adjustable bottom-dump buckets[18] was moved into position by the 12-ton engine and then placed with the crane in the foundation and the lower sections of the piers. As the work progressed the concrete was placed in the arch rings, bench walls, and floor system by guy derricks with 80-ft. masts and 75-ft. booms.

The second plant for concreting the south approach consisted of a ¾ yd mixer mounted on a light track adjacent to the west side of the bridge. Stone, sand and cement were unloaded from standard gauge cars near the particular point where the mixer was in operation. As the up-grade here was as high as 8% all cars were pulled into position by a hoisting engine. Concrete in the foundations was placed almost entirely with chutes and dumped into the form with buggies of 5-cu. ft. capacity.

The third plant for concreting the north approach where the viaduct begins at the same grade as the present city streets, consisted of a ¾-cu. yd. batch mixer mounted on flat tires so as to be moved readily over roads from one point to another. By necessity all sand, stone and cement were delivered by teams. For foundation work the mixer was located directly over the pits and all concrete discharged from the mixing drum into the foundation.

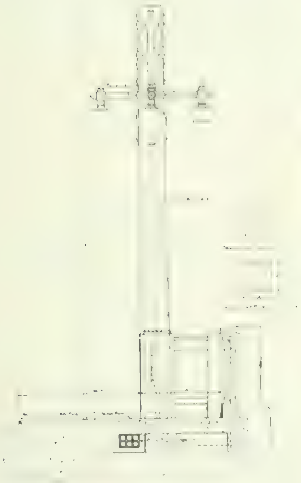

Fig. 15—Detail Section of Combination of Light Standard and Trolley Pole Used

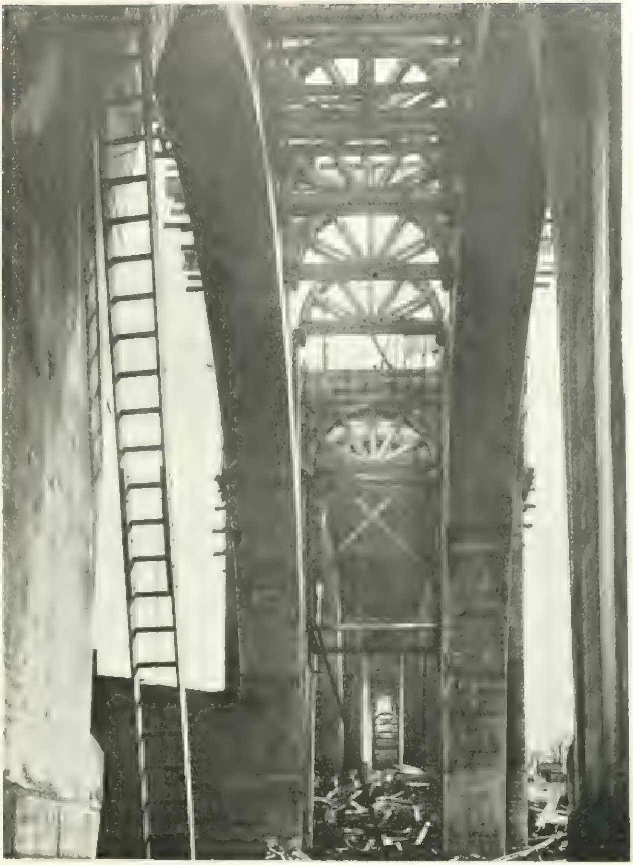

Fig. 14—One of the 120-ft. Arches From Below

This view shows in a most interesting way the avenue of the bridge piers. One of the 120-ft. arches shown in the immediate foreground at the right and left; above is shown in place the centering for the spandrel arches

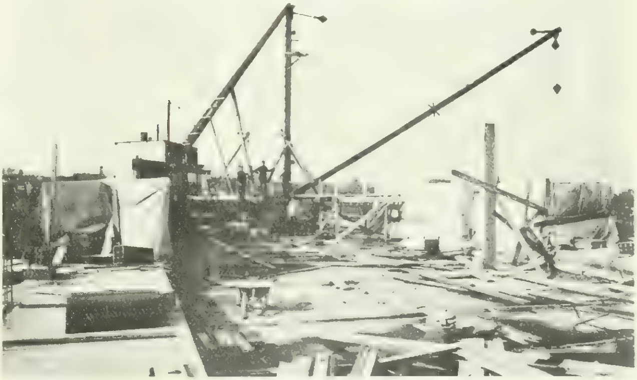

Fig. 16—Finishing the Concrete Sidewalks and the Deck of the Bridge

In the center background is shown the stiff-legged traveling derrick used after the derrick towers on the bridge piers were wrecked. The view shows in detail the canvas housing used to protect the concrete sidewalks from freezing

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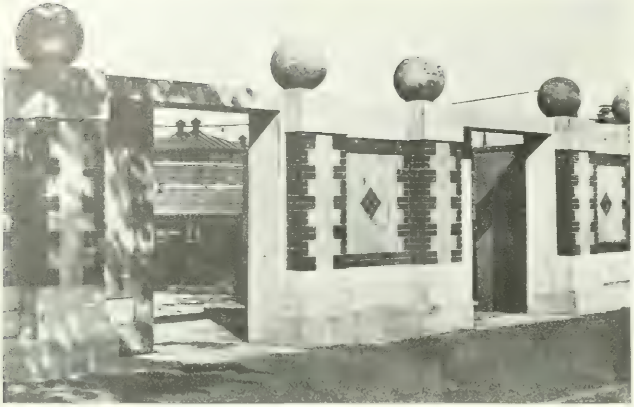
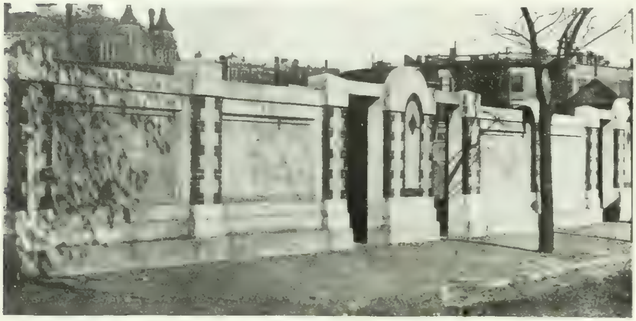
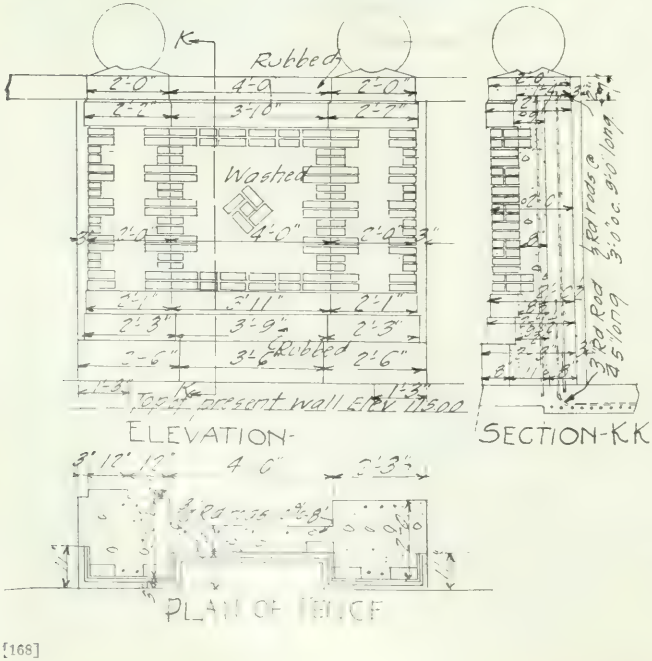
[18] Insley Mfg. Co., Indianapolis







Later on the mixer was placed on false work at the bridge grade and carried by buggies from the mixer into the forms.

Supports for the Steel Centering: The supports for the steel centering were provided by concrete lugs cast with the main piers. The base plates of the columns rest upon wedges (Fig. 7), which rest upon the grillage, the concrete brackets supporting the grillage. Under each column are four adjusting wedges of cast steel, 4" and 2" thick, 12" wide and 18" long. The grillage consists of three 12-in. I-beams stiffened with 5"x3½" "L"s. Ten-ton screw jacks are provided to sustain the weight of the centers themselves until the alignment is completed, when the strain is taken off the jack. A U-shaped clamp of 1-in. bolt iron is clamped around each pair of wedges to prevent any possible lateral motion. The total load on each grillage is about 120 tons. No difficulty was encountered in striking the centers.

REINFORCED CONCRETE FENCE (SEE NEXT PAGE) ILLUSTRATIONS AT THE LEFT—TOP TO BOTTOM:

FIG. 1—DETAIL VIEW OF ONE OF THE ENTRANCES STADIUM STATIONS, BOSTON. The rolling gate is seen partly open at the left of the illustration.

FIG. 2—GENERAL VIEW OF THE CONTRASTED WALL PANELS AND ENTRANCES

FIG. 3—ELEVATION AND SECTION OF A PANEL AT AN ENTRANCE

FIG 4—(ABOVE) THE WALL FROM THE REAR OR TRAIN SIDE SHOWING THE STEPS AND THE ROLLING DOORS

Fence With Concrete Rolling Doors

The recently completed "Stadium" station of the Boston Elevated Ry. presents many interesting uses of concrete. This new station, adjacent to the athletic field of Harvard University, has been built principally to handle the crowds attending the athletic events in the field.

The station is essentially a concrete platform about 452 ft. long. At one end this platform fans or widens out for the main entrance, and along the side it is served by eight entrances. The wall proper, sections of which are shown in the accompanying illustrations, is of solid concrete 7′ 6″ high. The pilasters are 24″ x 24″ and in general about 12′ o. c. As shown in Fig. 2, the portion of the wall at an entrance is embellished with brick in a most attractive manner. The two 12-ft. panels between entrances are finished with contrasted acid-washed and rubbed surfaces. The central portion of the panel is washed with acid while it is green, bringing out to a certain extent the texture of the concrete, while the borders when hard are rubbed to a smooth finish with carborundum[1] stone. Each pilaster is finished with brick quoins.

The ball ornaments seen at the top of the posts were cast separately with a pin in the bottom, and were placed in the concrete of the post at the time the post was cast. The posts were cast in situ with place for the quoins provided, and the brick work was laid up afterwards. The same procedure was followed in the brick inlay decorations on the panels at the entrances. The panels were cast in place after the pilasters had set.

Concrete Rolling Doors: The gates, as shown in Figs. 1, 4 and 5, are of solid reinforced concrete. While they harmonize very well with the wall as a whole, and are permanent, yet, owing to their weight, they are operated with some difficulty. Fig. 5 shows the gate in detail, and Fig. 6 a detail of the roller used. The gate is reinforced with rectangular wire mesh.[2]

The structure was designed by Robert S. Peabody, cons. arch. of the Boston Elevated Ry., and every effort has been made to produce a station in keeping with the architectural development of Harvard University toward the Charles river. For notes and illustrations of this work we are indebted to C. S. Sergeant, vice-pres. of the Boston Elevated Ry.

In Watertown, S. D., a recent vote of the property owners who had as many votes as feet of frontage on streets to be paved, decided in favor of concrete paving by a vote of 3,010 to 1,400 and the city engineer is now preparing specifications for 16 blocks of concrete pavement.

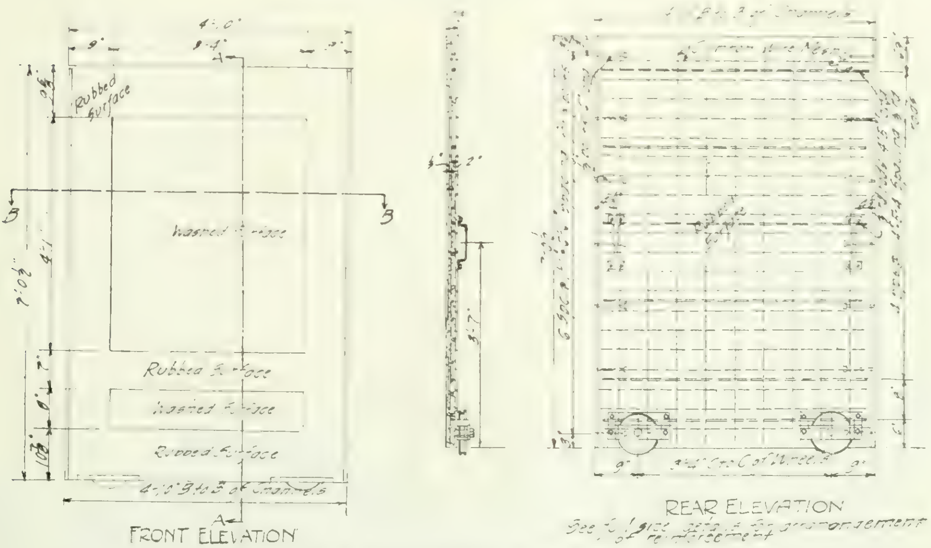


Fig. 5—Structural Details of the Rolling Door

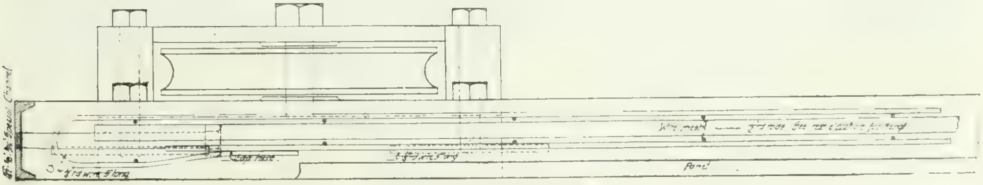


Fig. 6—Detail of the Roller Used

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[1] The Carborundum Co., Niagara Falls, N. Y.

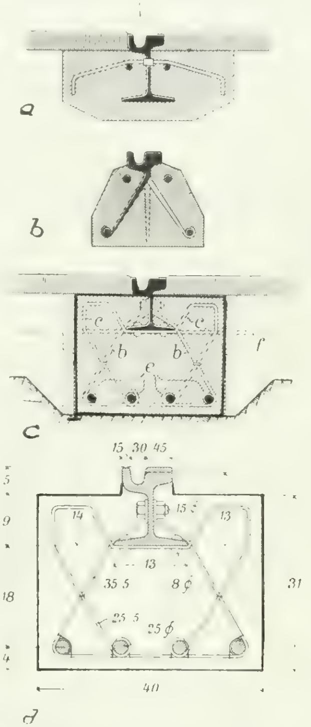
[2] Clinton Wire Cloth Co., Clinton, Mass.

Concrete Roadbed for Track Construction

At the present time it can hardly be stated that the use of concrete for railway ties is a success. There is something inherent in the present transverse stringer construction that requires a tie which is to a certain extent elastic. If the rail could be continuously supported on a rigid base, the situation would be different, and the following notes abstracted from a recent issue of *Beton und Eisen* (Berlin) describe some recent improvements in longitudinal or stringer rail-bed construction.

In the accompanying illustration the stringer shown in *a* is not reinforced, except for the stirrup which was supposed to give a firmer bond between rail and tie. This design did not seem to give full assurance that the rail would not be loosened through the constant jar and impact to which street railway tracks are exposed.

A later experiment in this line, which seems to offer some points of interest and solve the problem to some extent is a unit reinforced concrete stringer brought out by the Maillard Co., in Zürich. This is shown in *b* and *c* of the sketch. The first design (*b*) which has been discarded in favor of the second (*c*) used a rail whose foot was split, being bent alternately left and right. The longitudinal steel reinforcement was placed within the bent ends of the rail base. The objection to this construction lies in the fact that the axle pressure exerted by the cars on the rails is here transmitted directly to the concrete, and as it may be taken for granted that this pressure will be excessive, in the long run the concrete would tend to give and the rails would sag. This, of course, is to be avoided in a good roadbed. In *c* is shown the new design which apparently meets all requirements. The lower section of the stringer, which is always exposed to internal stresses when under a load, is reinforced by the reinforcement *ee* which runs the entire length of the rails. The steel stirrups *bb* connect the longitudinal reinforcement with the rail, which in this case forms a part of the upper compression member of the stringer. A second set of special U-shaped stirrups (*cc*) which lie next to the stirrups *bb* is used, in the first place to form a firm bond for the concrete in the upper member, and in the second place to link it firmly to the reinforcement in the lower member. In this way the upper and lower members of the stringer are really connected so as to resist any tensile stress. These stirrups are placed throughout the stringer at intervals of 25 cm. (10″). Such an arrangement prevents movements of rails in relation to the street pavement, and the vibrations of the rails are decreased by the great rigidity of the concrete ties. The diagonal steel rods (*f*) can be used to anchor the concrete ties more firmly in the concrete used for the pavement. The various lengths of rails are joined by welding. The detail dimensions for this new design are given in *d* and are in metric measure.



Sectional Sketches Showing Development in Longitudinal Rail-Bed Construction
In sketch *d* the dimensions shown are in centimeters

The following loads have been taken as a basis for these dimensions:

Axle pressure: $R=4{,}000$ kg. (8,800 lbs.)

Load during operation: $P=1.5R=$ 6,000 kg. (13,01200 lbs.)

Pressure of ground: $p=0.5$ kg. per sq. cm. (7.1 lb. per sq. in.)

Resistance moment of worn rail: $W=144$ccm (8.4 cu. in.)

Width of rail base: $f=13$ cm. (5.2 in.)

Permissible rail stress: $s=1{,}000$ kg. per sq. cm. (14,200 lb. per sq. in.)

Permissible concrete pressure: $b=30$ kg. per sq. cm. (426 lb. per sq. in.)

Width of railway tie: $c=40$ cm. (16 in.)

The moment to be transmitted for a single load will be equal to

$$M=\frac{P^2}{6 \text{x} c \text{x} p}=\frac{6000^2}{6\text{x}40\text{x}0.5}=300{,}000 \text{ cm. kgs.}$$

or in English units

$$M=\frac{13{,}200^2}{13.2\text{x}16\text{x}7.1}=116{,}197 \text{ in. lbs.}$$

The cost of the above railway stringer is, of course, much higher than that of any other design. On the other hand, this first cost is more than offset by the lower repair costs in service, less chance of traffic interruption, and finally less noise during operation of cars, as the decrease of rail vibrations will decrease the noise caused by passing load on the rigid roadbed.

A. H. Brown R[illegible] Leesburg, Ind., Cosmo C. Ellwood, Winona Lake, Ind., Architect

Thomas L. Dates Residence, Owen Sound, Ont., E. C. Van Leven, Architect, Detroit.

The Brown [illegible] in plan, built of Ideal concrete block, 8″ x 8″ x 16″, plain and bevel face, cost about $6,800, using 3,320 block. The house was built by McRoberts & Holloway. The living room is 14′ x 19′, library 12′ x 17′, dining room 14′ x 17′, hall with vestibule 9′ x 26′; besides these rooms there are also on first floor—kitchen, pantry, scullery and toilet room; the second floor has four bedrooms about 13′ x 15′ with closets, bath room 7′ x 10′ and sewing room; there is a den in the attic

The Dates house, built of Ideal concrete block, vertical tooled and plain faces, 8″ x 8″ x 16″ and 8″ x 10″ x 16″, by Ed. Martyn, London, Ont.; cost complete $5,650. The house is 37′ 6″ square

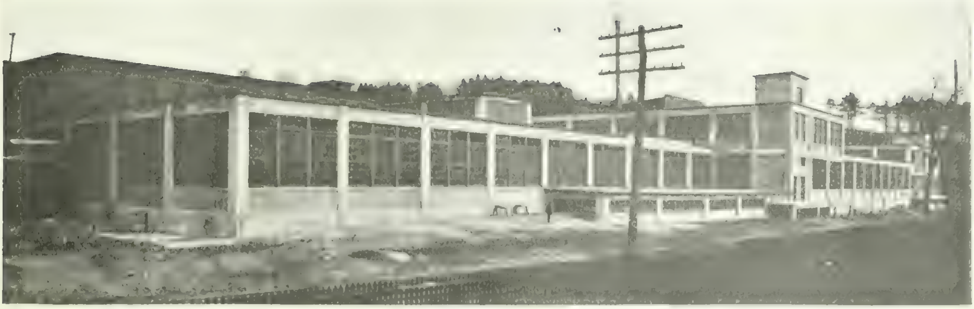


Fig. 1—General View of the Completed Beam and Hide House [illegible] of American Hide & Leather Co., Lowell, Mass.

Tannery Buildings in Reinforced Concrete

Demands of Present Day Tannery Construction are Met with Reinforced Concrete

There has recently been completed at Lowell, Mass., a reinforced concrete beam[1] and hide house for the American Hide & Leather Co. In this building, which is adjacent to the calfskin tannery, the skins are thoroughly cleaned and all of their constituents unnecessary in preparation for tanning are eliminated. This necessitated building a large number of concrete vats for holding the skins during the various processes.

The total length of this structure is 480′, while the width is 100′ for about 3-5 of the length, the rest of the building being 75′ wide. At the south end is located the hide house, 100′ long, with two stories and basement. For the next eight bays the structure is one story, 10′ and 17′ wide monitors running its length and located at the middle and at the east side respectively. It is here that the liming vats and the soaks are located. Adjacent to this portion of the building, and extending for three bays, is the two-story beam house with fleshing cellar. For the last nine bays the structure is one-story with a monitor over the fifth bay. Wooden sash is used throughout, the windows being of the ordinary pivot, stationary, and sliding types.

The raw materials are received at the hide house, and leave the building ready for the tannery at the north end. A mushroom system of construction has been used in the hide house, the live load being figured at 400 lbs. per sq. in., while 100 lbs. per sq. in. was the load figured for the floor slabs. In the basement the columns are 24″ x 24″, while on the first and the second floor they are 20″ x 20″. There are five rows of columns each way spaced generally 16′ 6″ on centers. The basement floor is a 6-in. slab, this dimension being increased to 8½″ for the two other floors. All of the floors are slightly pitched toward the center of the building. On the side of the hide house adjacent to the railroad, is a concrete platform. On the east side of the hide house is a concrete retaining wall, the finished grade being just below the level of the second floor.

With the exception of the hide house, the entire construction is of the beam and girder type. All floors with this type of concrete construction are designed for 150 lbs. live load. In the liming and soaking department the columns are 14″ x 14″ and spaced about 17 ft. o. c. lengthwise. Starting on either side of the center aisle leading from the hide house are two groups, each consisting of 20 soak vats, and beyond these are two groups each of 35 lime vats. The purpose of the soaks is to bring the skins into their former "green" condition, since the raw material is received in a dry or salt-cured state. The skins, similar in size, kind and weight, are placed in the soaks and cold water is turned on them until they are completely covered. Here they remain over night. The purpose of the liming process is threefold; the skins are swelled by distending or separating the fibers; the hair roots are loosened, and the perishable animal matter of the skin is dissolved or decomposed. Between the vats and under the floor is a concrete sewer. Between the soak and the lime vats is a row of five sulphite vats. The bottoms of these vats have a slight pitch to the outlets and they are 8′x8′ with a 6-in. concrete wall between, while the bottom of the vats is 10″ thick. Concrete richer than used in the building was used in the construction of these vats. In the beam house the columns are 20″x20″ on the first and the second floor. The bays here are 20′ 10″ while the spacing of the columns across is 18′ 6″. The hair-washer trough runs across the first floor of the beam house and is 36″ x 18″. At the center of the beam house and on the first floor are two groups of paddle vats each 8′ x 8′ 6″. At one side, a space is partitioned off for an office. In the beam house will be located the unhairing machines. The unhairing process removes the epidermis and leaves the true skin or grain exposed. On the second floor of the beam house will be located the hair dryers. In the following sections of this building are located the bate vats in two rows at the center, there being nine vats 8′x8′ in each row. Following these come two more groups of paddle vats located in the center with six in a group. At either side of the building here are located other paddle vats, six in a row.

The heating system consists of pipe coils hung on standard cast iron pipe rolls with adjustable hangers. None of the radiating surface was put under the windows on account of danger of burning hides. A vacuum system is used, with two 5½″x8″x7″ single-acting pumps, one being located in the beam house and one in the hide house. All of the steam pipes are covered with 85% magnesia. Over the eighth and the ninth bays from the north end will be located two rows of tanks, four in a row, the capacity of each being 25,000 gals. One of these tanks will be connected to city

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[1] In tanning, a beam is a sloping board or frame upon which hides are worked

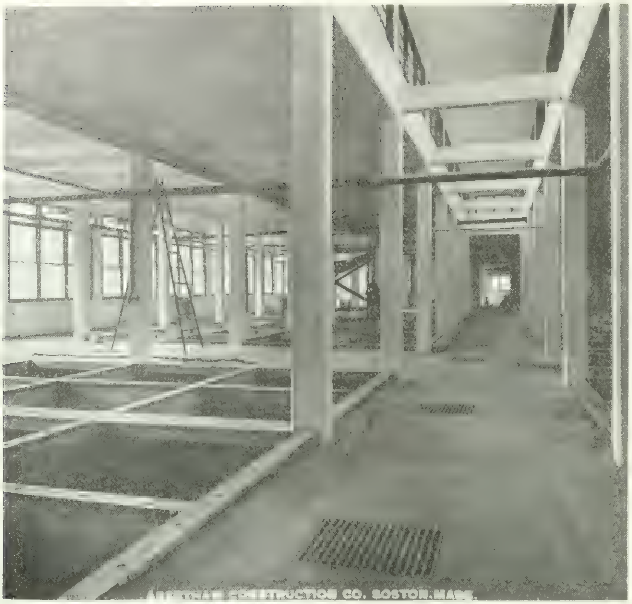

FIG. 2—INTERIOR OF THE BEAM HOUSE, AMERICAN HIDE AND LEATHER BLDG., LOWELL, MASS.
This shows the typical roof construction and the monitor over the central corridor. At either side of the passageway the vats are shown

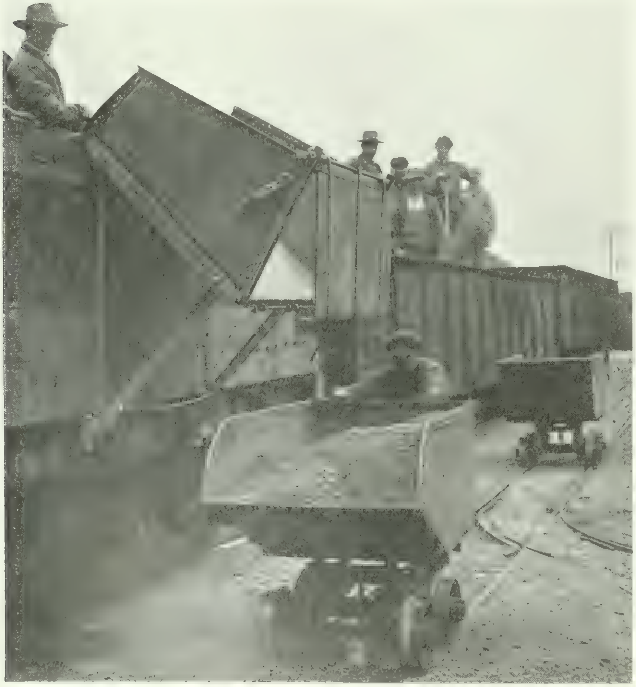

FIG. 3—HANDLING CONCRETE MATERIALS WITH UNLOADING CHUTES AND DUMP CARS
The chutes or car hoppers are filled by the shovelers in the car, and are emptied by the man pushing the car. The cars rotate and dump either forward or sideways

water only, while the others will be filled with river water which will be used in the vats in the winter, but in the summer when the river water is too warm, the city water will be available. All vats can be provided with either city or river water.

The construction company unloaded the aggregate from flat cars, provided with quick unloading chutes, into industrial cars which were hauled to either of the two mixers[2]. The concrete was hoisted and conveyed to the forms. Concrete was proportioned 1:2:4, the mixture for the retaining wall being slightly leaner, while that for the vats was richer.

Lockwood, Greene & Co., Boston, designed this building and made plans for the heating, manufacturing, steam and water piping. Charles H. Stehling Co., Milwaukee, planned the layout of the machinery and general plant arrangement. The contractors were the Aberthaw Construction Co., Boston.

Factory-Made Sidewalk Slabs Used in Minneapolis

For some time the City of Minneapolis has been laying concrete sidewalk using pre-cast slabs. Ellis R. Dutton, assistant city engineer, writes that the city has about 800 miles of concrete stone sidewalks built of what are called tile. These sidewalk tile are made, some 18" x 18" and some 24" x 24" and 2" thick. The lower 1½" of the slab are made up of 1:5 mixture of cement and gravel. The top ½" consists of 1:2 mixture of Portland cement and sand. Most of these tile are made in the winter by various contractors and are allowed to cure for several months before being used. Practically all of the actual construction is done in the summer. When these tile are laid they are set into a mortar 1" thick made of a 1:3 mixture of sand and natural cement. Mr. Dutton says: "We have had very little trouble with this construction, the only difficulty being that frost and the roots of trees sometimes displace the stones, making the walk uneven in places. This would probably happen in any class of construction. The cost of this construction is just about the same as for the walks which are laid in place, or about 72c per sq. yd. In making these soft walks, as the walks are called which are laid in place, the bottom course is 2½" thick mixed 1:4 and the top course ¾" thick, mixed 1:2. The walk is cut into squares about 3' on a side.

Footprints

He left his footprints, Ryan did,
  Where others dared not tread;
And though men warned him, fear he
    scorned.
  His eyes were fixed ahead.

He left his footprints, Ryan did,
  As he went down the street.
He left his footprints on the walk—..
  Deep in the fresh concrete.

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[2] Cars and mixers manufactured by the Ransome Concrete Machy. Co., Dunellen, N. J.

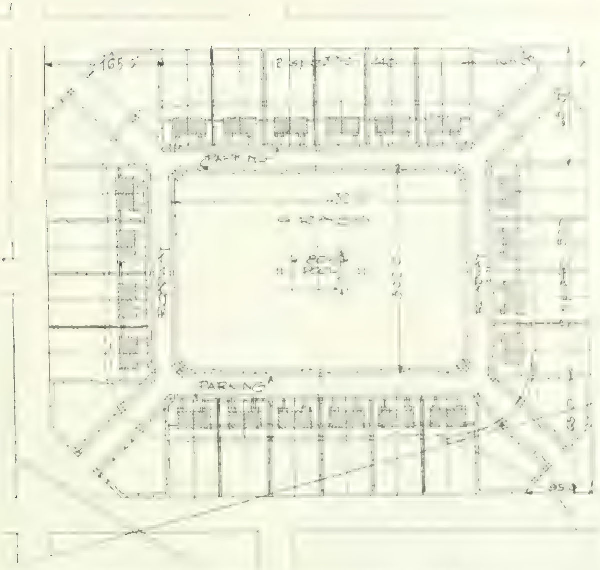


Fig. 1—Plan Showing the Layout of the Houses and the Track for the Construction Plant

Concrete Homes for Mine Workers

One by one the great railroad systems have given up the old styles of construction, and have adopted reinforced concrete wherever possible, realizing the permanency of such material and the saving effected in curtailing up-keep, painting, repair and fire risk. The Delaware, Lackawanna & Western R. R. Co. has been especially progressive in the adoption and use of reinforced concrete in stations, signal-towers, etc., as well as in the heavier forms of construction, and when this company proposed building a group of model homes for its mine department at Nanticoke, Pa., an exhaustive study was made in the concrete field to discover a method by which such a building could be erected of the most economical materials and by the best method.

The Feb., 1912, issue of *Concrete* presented what details of this work were available at that time. The 20 structures, or 40 fireproof houses, are grouped around a rectangular park or play-ground about 400 ft. by 600 ft. Each building constitutes two dwellings of seven rooms. The entire group is fireproof. Reinforced concrete is used throughout the walls, floors, partitions, roofs and stairways, the only wood-work being the sash and doors.

Before construction, a temporary track was laid around the group, and a mixing and elevating machine was mounted upon a flat car. Materials were delivered on other cars, and after one building was poured, this unique construction train proceeded to the next site. The concrete was spouted from the tower into the steel forms at the various parts of the building.

The forms are pressed steel plates in standard units and are rigidly attached and spaced with wedge connections. These forms are swung up one over the other, each trough as it were in turn being filled with concrete. The same equipment was utilized for partitions, roofs and floors, and owing to the smooth surface obtained, plastering has been largely omitted. The interior and the exterior have a paint finish only.

The concrete used throughout was cinder concrete,[3] made up of 6 parts clean steam cinders to 1 part of cement. To the cement used, by volume, ½ part of hydrated lime was added. This mixture forms an extremely dense, yet light construction, making an excellent non-conductor so far as heat and cold are concerned, eliminating the interior dampness due to condensation. The buildings are exceptionally dry. In the foundations, crude oil was added to the concrete when mixed, for waterproofing purposes.

For several smaller one-story buildings, what is known as the "one-day" process was employed. The steel forms were set up and immediately poured full for the entire story, and the forms were removed on the second day, cleaned and taken to the site of the next building, where the proces was repeated. This "one-day" process is of especial advantage in the construction of one-story buildings, such as freight, tool and section buildings, as permanent, inexpensive buildings can be rapidly completed. The equipment, while of the standard unit type, is adjustable so that 100 different dimensions and types of buildings can be poured with one outfit, and being of pressed steel it is practically indestructible.

[illegible] this on p. 158 of the Mar., 1913, issue

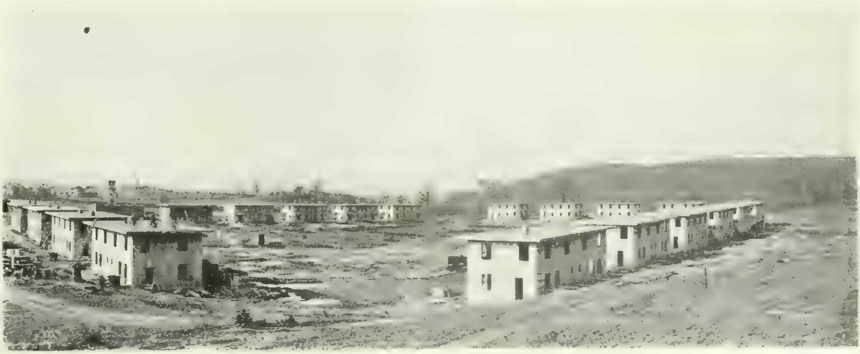


Fig 2—General View of the Concrete Village at Nanticoke, Nearing Completion

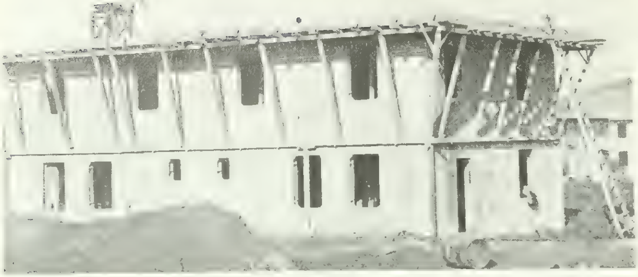


Fig. 3—An Exterior View of a House Showing Roof Construction
Note that the overhanging cornice is supported on inclined 4x4's which are in turn supported by a horizontal 4x4 held in place by bolts into the wall and vertical 4x4's to the ground

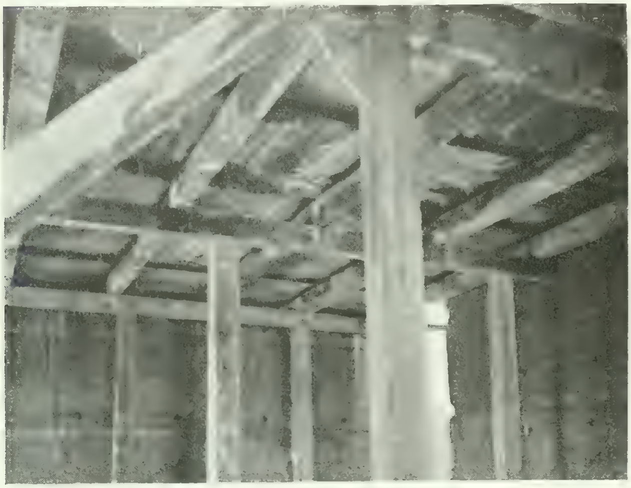


Fig. 4—Steel Plates Used in Floor Centering
The steel forms shown in this view have been used five times in floor centering, and 15 times as side wall forms. The timber has been used six times, with but 1% renewal of lumber required each time. Steel forms make tight centering as shown by the absence of concrete on the lumber

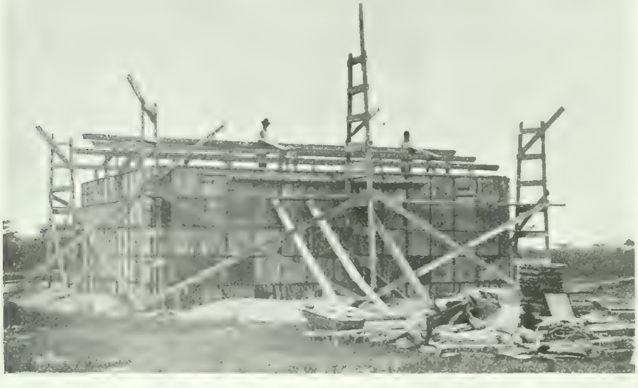


Fig. 6—View [illegible] "One-[illegible]" Process of Casting One-Story Buildings
Five courses of steel plates set all around the building and all the concrete poured at one operation. Note the ingenious arrangement of the scaffold support at the corner.

While cinder concrete does not develop such great strength as is afforded by stone or gravel aggregate, for the lighter forms of construction it has proven even preferable. In these poured buildings walls of 6″ and 8″ thickness with 4-in. reinforced partitions make exceptionally rigid and substantial structures, at the same time using up what is to most railroads a waste product. While the miners' homes illustrated are very simple in plan and design, lattice, window-boxes and plants make this an attractive group of houses.

The following is an itemized sheet giving the cost of one of these two-family buildings.

Excavating	$100.00
Concrete	200.00
Forms, labor	225.61
Carpenters' work	103.00
Cement finishing	50.00
Masonry	50.00
Porches	40.00
Stairs	75.00
Plastering second story, ceiling only	17.00
Mill work	120.00
Lumber for centering	78.00
Frames	30.00
Finishing and labor	150.00
400 bbls. cement	420.00
100 cu. yds. of sand	45.00
200 cu. yds. of cinders	40.00
Plumbing	96.00
Labor on plumbing	50.00
Hardware	25.00
Painting	150.00
Superintendence	180.00
Slag roofing	76.00
	$2,320.61

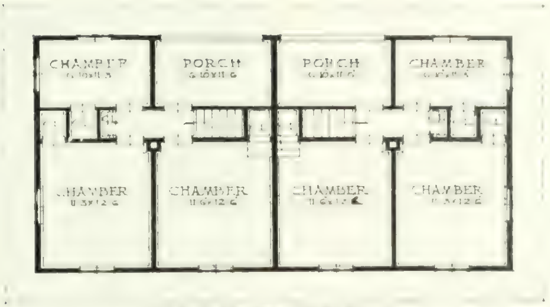
This means of course, one structure, or two dwellings.

A hose for cleaning house:—It tenants leave their apartment in an unsanitary condition, the whole can be flushed out with a hose; all corners are coved and there is no place for the lodgement of germs, vermin or insects. A bon-fire on the living-room floor could do no damage other than that from the smoke resulting therefrom.

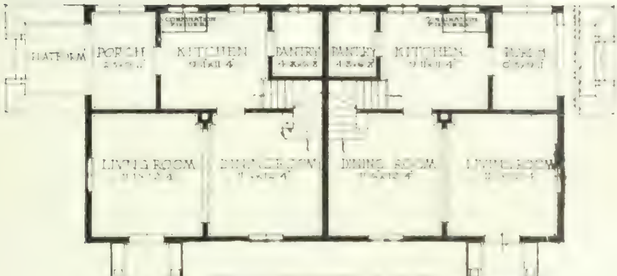
Gov. Sulzer, of New York, has appointed a special commission to serve, without compensation, for the purpose of collecting facts and making such recommendations to the governor as may seem fitting, with regard to the construction and maintenance of roads and the proper administration of the Department of Highways. Members of the commission are:

James E. Gaffney, chairman, 1 Madison Ave., N. Y. C.; Geo. H. McGuire, secretary, Union Bldg., Syracuse; Chas. E. Treman, Ithaca; Edward H. Butler, 218 Main St., Buffalo; Col. William D. H. Washington, 257 Fifth Ave., N. Y. C.; Prof. A. M. Blanchard, Columbia University, N. Y. C.; P. L. Schultze, City Engineer, Troy; Wm. Pierrepont White, Utica; Eugene W. Stern, 103 Park Ave., N. Y. C.; John F. McDonald, Niagara Falls; Henry C. McCord, Merrick, L. I.; Arthur A. McLean, Newberg; John J. Hopper, 215 W. 125th St., N. Y. C.; Gen. Amasa J. Parker, Albany; Augustus Thomas, 55 E. 53rd St., N. Y. C.

The building regulations of N. Y. C. require that the reinforcement rods in slabs shall not be spaced farther apart than 2½ times the thickness of the slab.



PLAN OF SECOND FLOOR



PLAN OF FIRST FLOOR

Fig. 2—Plans of First and Second Floors [illegible]

An Illustration of Rapid Construction

In the building construction of the past few years, reinforced concrete has furnished some wonderful demonstrations of its efficiency in rapid construction. An illustration of this was the building erected for the U. S. Light and Heating Co., at Niagara Falls, N. Y., by the Leonard Construction Co. (Not Inc.), Chicago. This company practically designed, purchased and constructed a reinforced concrete building 56'x320', three stories high, in 70 calendar days. This included all foundation work, removal of centering, etc. In fact, the contractors state, the owner began to occupy part of the building within 40 days after the contract was awarded to the construction company. How this was done is covered in the following description:

The U. S. Light & Heating Co., manufacturing storage batteries and railway car lighting equipment at Niagara Falls, N. Y., decided early in May, 1912, to build self-starters for automobiles. Its plant at that time was working at full capacity, and as the efficiency of the self-starter was recognized immediately by numerous automobile manufacturers, resulting in large sales, it was necessary to increase the size of the plant at the earliest possible date, to provide the required manufacturing space.

The company invited several contractors to figure on a building, and in order to obtain quick action no attempt was made to draw up detailed plans. A sketch plan, however, was furnished, with the understanding that the detailed plans were to be made as soon as possible after the contract was awarded. The officials were prejudiced against a reinforced concrete building, owing to the supposed difficulty of attaching shafting to concrete ceilings. Bids were therefore taken on a building with structural steel frame, brick walls and plank floors covered with a finished maple flooring. When it was found that the steel companies could not deliver the structural steel in less than 60 days, and that it would take from 90 to 100 working days to complete thecontract, the officials were willing to investigate the possibilities of a reinforced concrete building.

The Leonard Construction Co., (Not Inc.), Chicago and New York, made a proposition to complete a concrete building within 70 calendar days. As this was not only the best proposition as regards time, but also price, a contract was entered into with this company for a reinforced concrete flat slab skeleton building with brick curtain walls; the first floor to be cement finish and the second and the third floor to have maple flooring laid on wood sleepers embedded in cinder concrete. The supposed difficulty of attaching shafting to the ceilings was easily overcome by placing cast iron inserts for ¾-in. bolts in the slabs at 4 ft. centers both ways.

Detailed plans were made while the footings were being put in, and the first story form work was so arranged that the outside curtain walls could be started as soon as the column forms were removed. The centering for the first story was taken down two weeks after pouring the second floor slab, and the foundations for the heavy presses and machines on the first floor were immediately placed and the cement finish laid, with the result that the owner began manufacturing operations in the first story within 50 calendar days from the time the contract was awarded.

The wood sleepers and cinder fill for the second floor were placed immediately after the second floor slab was poured, so that the cinder fill had an opportunity to dry while the second story form work was being erected. On this account the maple flooring for the second floor slab was safely laid without swelling as soon as the form work was removed under the third floor, and the company commenced manufacturing in the second story 60 calendar days from the time the contract was awarded.

The same method was pursued in placing the cinder fill on the third floor, and the entire building was occupied in 70 calendar days from the date the contract was awarded, thus giving the U. S. Light & Heating Co. 54,000 sq. ft. of available manufacturing space in time to turn out start rs at the rate of about 1,000 per month.

The numerous advantages of the concrete buildings were remarkably apparent in the interior when compared to the former mill constructed buildings of this company, and the prejudice of the officials against concrete was quickly forgotten as soon as the first story was occupied. Standing out prominently was the great advantage of having columns on 28-ft. x 20-ft. centers as compared to 10-ft. centers in the mill buildings, thus giving a large amount of additional working space in the same area of building.

The fine lighting effect, due to the wide column spacing, and, particularly, to the flat ceiling, was quickly appreciated. The numerous inserts combined with the flat ceiling gave the greatest possible leeway in the arrangement of shafting, and the superintendent of the plant was wonderfully pleased to find how quickly and easily the shafting hangers were attached. The flat ceiling also made a material reduction in the number of sprinkler heads required, thus reducing the cost of that item considerably.

After operating machines in the second story the superintendent of the plant was very much delighted to find that the vibration, distinctly apparent in the mill constructed buildings, was entirely eliminated in the flat slab building, and in consequence, when a machine was once lined up it was not necessary to be constantly adjusting it. The results obtained in this work have completely changed the views of the company's officials in regard to reinforced concrete, and it is safe to say that in the future this company will use nothing else.

J. R. White was consulting architect on the work for the U. S. Light & Heating Co. The construction was handled by the N. Y. office of the Leonard Const. Co. (Not Inc). The Concrete Steel Products Co., Chicago, furnished the details for the cantilever flat slab construction. The high rate of speed maintained was due in a great part to the hearty co-operation with the general contractors of Mr. White and W. L. Bliss, chief eng. of the U. S. Light & Heating Co.

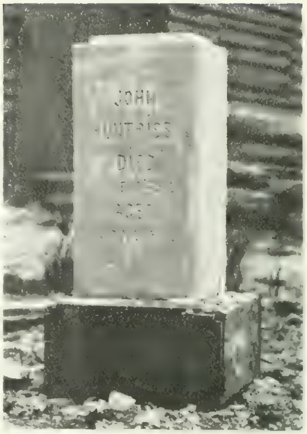
It is difficult to get a satisfactory wood floor on the ground—almost impossible. After five years' use, the Aberthaw Construction Co., Boston, took up a floor laid with plank driven into tar, with hardwood above this—and the plank came out in the form of powder. It is obvious that fermentation will set up wherever air is kept from timber that has any sap in it. The wood top is very nearly airproof. The tar is absolutely so. The result is, this disintegration of the plank will occur, as might be expected. For ground floors use cement, asphalt, or tar concrete if possible.

Much Work to be Done In Accident Prevention

Some of the largest corporations, which have been leaders in accident prevention in the United States, deserve a great deal of credit for their initiative. Compared with the small employer, however, their task is easy. They control many mills and large means. Their field is large enough to employ specialists of the highest standing; whereas, more than half of the wage workers in the country are engaged in the smaller shops. Employers in smaller plants all over the country are just as anxious to prevent accidents as the "big fellows," but they can secure only in a small measure and by co-operation the results obtained in the large establishments.

As Norman F. Hesseltine, mgr. of the Contractors' Mutual Liability Insurance Co., Boston, has pointed out, it is these results which should be the aim of every worker in this field. The mere collection and distribution of monetary compensation is an incident—very necessary and important—but still an incident. The whole future of the situation depends upon the intelligent attack of the problem underlying the whole field, and the minimizing of industrial accidents. Until this condition is reached, no relief can be expected from the present burden of compensation, with all its attendant sources of expenditure.

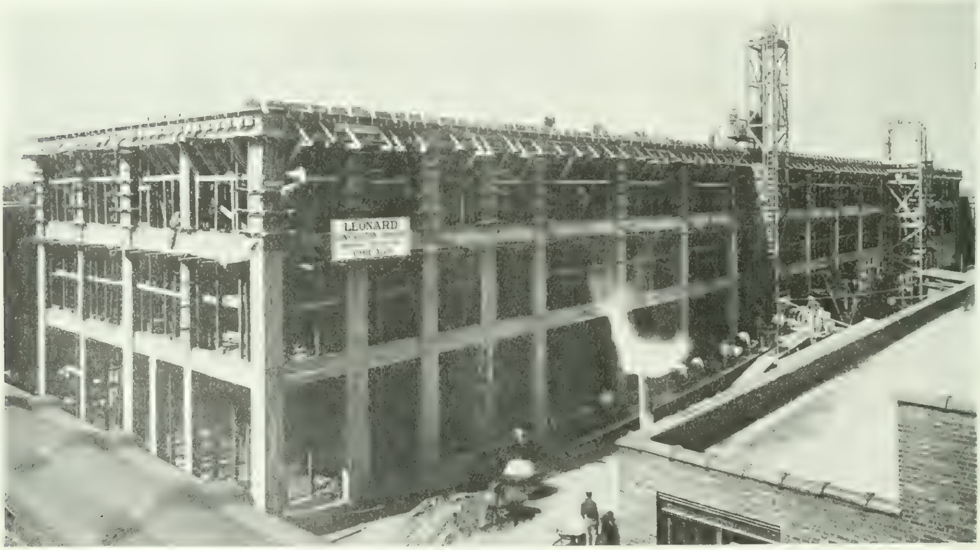
Forty-one miles of concrete roads will be built by Greenwich, Conn.—the voters having decided for an appropriation of $600,000 for the purpose. They will have a bituminous surface.



Home Made Tombstone in Central Newfoundland

A Concrete Tombstone In Newfoundland

While on a recent trip in Newfoundland, J. P. H. Perry, mgr. of the Contract Dept. of the Turner Construction Co., N. Y. C., took the accompanying picture of a concrete tomb-stone at Grand Lake Crossing This tomb-stone is about the only piece of concrete on the island aside from some railroad piers Grand Lake Crossing is about in the center of Newfoundland and is a most desolate spot. The only building in the vicinity is an English shooting lodge and it was quite a surprise to find concrete in such an out of the way place. The finish on the tomb-stone was remarkably good and the workmanship of the highest character.



Roof Centering in Place on a "[illegible]" Concrete Building for the U. S. Light and Heating Co., Niagara Falls, N. Y.

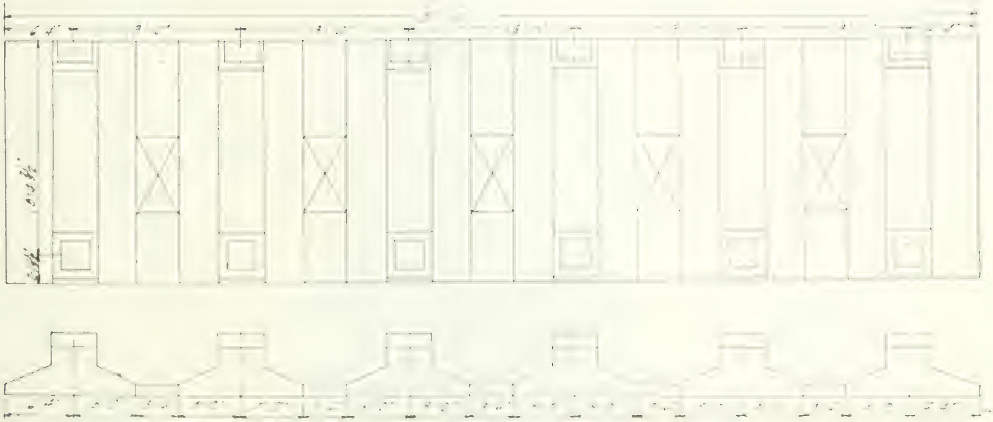


FIG. 1—FOUNDATION DETAIL SHOWING USE OF CANTILEVER MAT

New Loft Building at Memphis

The Lotus building at Memphis, Tenn., is an exceptional example in reinforced concrete construction and is generally known as the highest complete reinforced concrete construction in the South. As a matter of fact, it stands out notably in comparison with similar buildings anywhere. The Lotus building has a total height of 13 stories (12 stories and basement) and is built of reinforced concrete, from foundation to roof. It is a skeleton type of reinforced concrete design, with columns and spandrel beams in walls of reinforced concrete, and carrying light curtain walls at each floor level.

The building is located on Jefferson Ave., near Sixth St. It has natural light from four sides; all the windows on the side and the rear elevation are equipped with steel sash[1] to provide maximum daylight for the interior. The building will be devoted to light manufacturing, being subdivided to suit the tenants. It is absolutely fireproof in all respects, including metal doors on the interior and eliminating all combustible material. All elevators and stairs are encased, with fireproof partitions.

The structural design of the reinforced concrete presents many interesting features, and was prepared under the direction of A. J. Widmer,[2] St. Louis. The details were prepared in a careful manner, covering every feature of the design of foundation, girders, columns and floors. Footings for the columns are all of reinforced concrete, and owing to the great weight coming upon them and to the soil conditions, cover practically the entire ground area of this building. The footings of the interior columns and along two sides are of the isolated type, and are beveled off on the top side to secure economy of concrete. Along the two sides of the building, the foundations of the outside wall columns are combined with the next row of interior columns, as it was impossible to extend the foundation beyond the property line. The design of these combined footings consists of heavy inverted girders between the columns with a spread on either side to distribute the loading.

For the first four floors the columns are octagonal, and are both hooped and reinforced with a ribbed bar. Above the fourth floor, the interior columns are square, with corner chamfered and are reinforced with rib bars vertically, and banded frequently by wire. The exterior columns are naturally formed to agree with requirements of architectural effect. In the main, they are rectangular in shape and of a uniform width of 30″, flush on the outside and the depth varying with the loading Those of the three lower stories are reinforced with spiral hooping and deformed bars are used throughout in the columns for vertical reinforcing.

The building is 111′ 3″ by 91′ 1″ in size. The construction and design of the reinforced concrete for the second to the tenth floor are in a way typical of the entire design. The columns are spaced 13′ 10″ along the length of the building, and 18′ ½″ across the width. The concrete girders reinforced with trussed bars and rib bars extend across the width of the building between columns. These girders are 21″ deep to the top of the slab and 12″ wide. They add greatly to the general stiffness of the building across its narrow dimensions. A solid concrete slab, 5¾″ thick, reinforced with deformed bars, extends the full panel distance between these girders. Spandrel beams are provided between the reinforced concrete columns in the walls. The same general type of design is used on the other floors and roof, though different in the di-

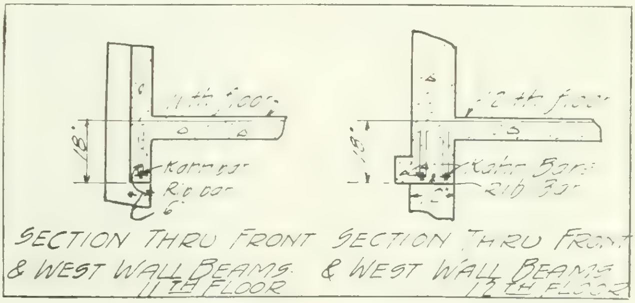

11th floor
18″
Kahn bar
Rib bar
6″
12th floor
18″
Kahn Bars
Rib Bars
SECTION THRU FRONT & WEST WALL BEAMS 11TH FLOOR
SECTION THRU FRONT & WEST WALL BEAMS 12TH FLOOR

FIG. 2—DETAIL OF WALL BEAMS, LOTUS BLDG., MEMPHIS, TENN.

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[1] United Steel Sash—Trussed Concrete Steel Co., Detroit

[2] Des. Engr., St. Louis office of the Trussed Concrete Steel Co.

mensions of the concrete and the reinforcement to take care of the different loading.

The entire architectural design of this building and its superintendence were handled by Weathers-Foley Co., Memphis, Tenn. Particular attention is called to the artistic way in which the exterior is made to conform to reinforced concrete construction, as well as the strong, impressive way of handling a building, which is to be used primarily for utilitarian purposes. The contractor was the Jefferson Building Co., New Orleans. The reinforcing steel used throughout the building was furnished by the Trussed Concrete Steel Co., Detroit.

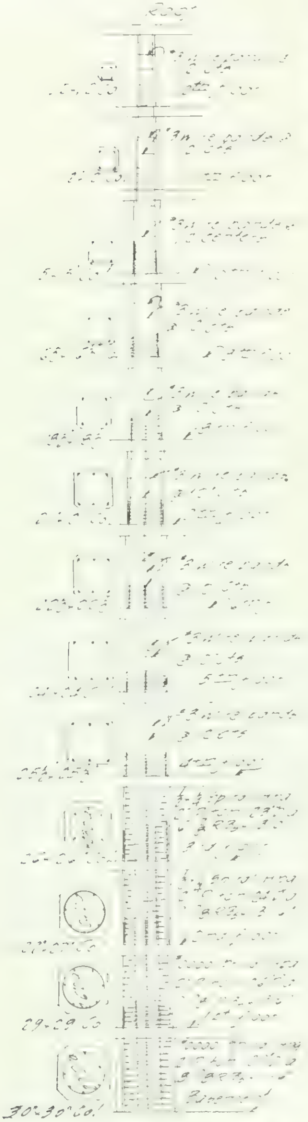


Fig. 3—Interior Column Detail, Lotus Bldg., Memphis, Tenn.

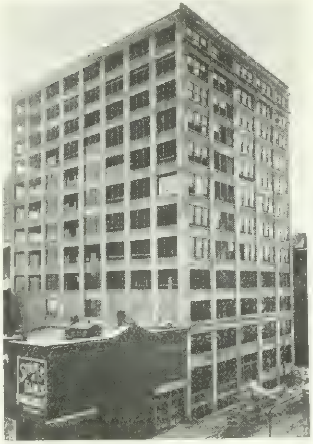


Fig. 4—The Lotus Bldg., Memphis, Tenn., Practically Completed
Note the detail of the window sill at the 12th story level

Construction of a Low-Cost Concrete Fence

A concrete fence was recently designed by R. V. Moss, surveyor, N. Y. C., for the Glen Ridge, N. J., tennis courts. A strong and durable fence was desired by the owners, and one that could be quickly erected, and at low cost.

At 12 ft. 1 in.-centers, 3 in. I-beams, 12′ 6″ long, were sunk in the ground to a depth of 2′ 6″, leaving 10′ of post above the surface.

The flanges of these beams were wrapped with expanded metal lath to a height of 6′ 0″ above grade to carry cement plaster.

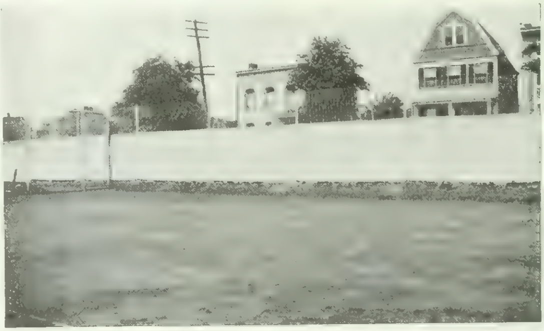
A 2-in. x 3-in. spruce bottom rail was placed between the posts along the ground and a top rail of the same size at a height of 6 ft. A ribbed metal lath[1] was placed between the rails, and covered with concrete to a thickness of 3″.

Above the concrete portion of the fence, wire netting was fastened to the height of 4′ making the entire height of the fence 10′ 0″, 6′ of which is concrete and the remainder wire mesh.

The cost of this type of fence is low, especially for the concrete portion of it which, in this case, is increased by the fact that the I-beam posts extend 4′ above the concrete to carry the netting. The concrete portion alone cost about 25 cts. to 30 cts. per sq. ft., including the contractor's outfit which made the cost of the 6-ft. fence from $1.50 to $1.80 per lin. ft.

The I-beam posts were set in the ground in concrete piers, and the metal plate forming the fence between the posts was carried down to the top of the pier. The flanges and web of the I-beams from the top of the piers to the top of the metal fabric were wrapped with expanded metal lath on which was applied cement stucco containing a waterproofing compound.

The portion of the I-beams above the ribbed fabric or the concrete portion of the fence, was left bare and painted, this upper portion carrying the wire netting used in certain portions of the fence.



A Fence for Tennis Courts, Using Steel and Wood Frame with Cement Plaster and Metal Fabric Panels

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One of the most annoying features of plaster when applied to wood lath, has been the fact that after a short time the entire surface would be very badly disfigured by cracks and streaks, showing the location of every lath and wood support. These cracks are due to the expansion and contraction of the wood lath which is caused by the lath absorbing moisture and then drying out. The streaks can sometimes be avoided by putting on a greater thickness of plaster, but this merely delays the ultimate discoloration, caused by the lath absorbing the moisture from the mortar in contact with it. This leaves alternate wet and dry strips. The wet ones absorbed dust from the atmosphere, causing the streaks on the plaster. The use of metal lath removed these difficulties, but it was found necessary to use a metal furring strip over wood supports in order to secure a permanent support.

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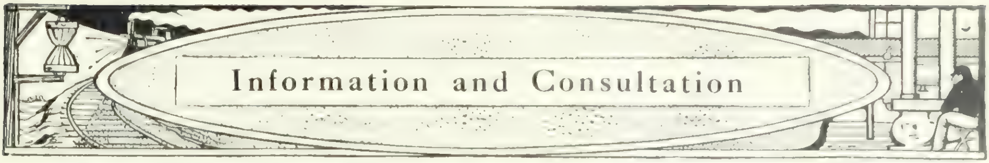
[1] "Rib-Tres," The Berger Mfg. Co., Canton, O



Information and Consultation

The Questions and Discussions in this Department are of interest and real value. Speaking for our questioners, we earnestly ask readers to discuss the questions submitted. For men in field and office, let this be a real consultation section, an exchange of ideas, among those who have, and those who have not, solved some of the problems of structural concrete. Questions and Discussions are cordially invited.

178. Wood Finish Floors on Concrete Base

"Assume light building construction such as office buildings and school house floors, where it is necessary to secure a wood finish floor over a structural concrete base. Are there any data on the following suggested specification?

"Use 1-in. boards, rough, embedded in a tar-sand mixture spread upon the concrete base, no more thickly than to make up for unevenness in the concrete surface, and to give a uniform surface. To this nail the finish flooring.

"This is suggested to eliminate the necessity of using sleepers embedded in concrete, for in the light of Prof. Woolson's discussion (Consultation 160)[1], we run therein the risk of dry rot. What is the possibility of disagreeable odors from the use of tar?"

178. DISCUSSION: SPIKING A SUB-FLOOR TO A CINDER CONCRETE CUSHION

The following paragraphs, while not answering the specific question, yet bring more information to the general problem of wood floors on concrete slabs, and suggest a detail which, we believe, is not in general use, and that is spiking a sub-floor to a cinder fill.

Where a hard wood floor is required over concrete slab, the common way is to lay beveled screeds about 12 ins. or 15 ins. o. c., bed these in cinder concrete and over them lay a 1-in. or 2-in. rough floor. On top of this floor, the hardwood, ⅞" thick as a rule, is laid. An excellent hardwood floor can be laid by putting down ⅞-in. form lumber on top of the rough concrete, laid diagonally to the finished floor, and on top of this nailing the hardwood. The way this is done is described in a recent letter from L. C. Wason,[2] as follows:

The building on which this detail was used was the carpenter shop at the Charlestown Navy Yard. On top of the stone concrete of the floor construction we spread 2" of cinder concrete. This was straight-edged to a true surface, and when it was about three days old we spiked a rough floor to this. The spikes were driven in diagonally and were heavy wire. They held very well. If driven perpendicularly, the nails usually buckle. This under floor proved tight; and to this the finish floor was laid. The writer examined it after several years of service and it was still in good condition. It was laid about 12 years ago.

The experience of the Aberthaw Const. Co. indicates that the boarding should be laid the way of the greatest traffic, that is, trucking should not run at right angles to the floor boards if this can be avoided. Where the progress of traffic is definite it will pay to change the direction of the boarding where the turn in the traffic comes.

In whatever direction the boarding is to be laid, the hard wood is much better square-edged than tongued and grooved. Where square-edged, if the floor boards warp, the edges do not split. If repairs are necessary, a board can be taken out without ruining the floor around it, and it will be found that the boards will wear better when square-edged than when grooved.

For wet floors, maple is not to be recommended. Rift hard pine, which is full of pitch, is very much better. There are preparations sold for preserving wood floors from the effect of wetting which are quite worth looking into.

* * *

270. Concrete Paving in Europe

"To what extent, if any, have concrete pavements been used in Europe?"

270. DISCUSSION BY MEMBER OF BERLIN, GERMANY, DEPARTMENT OF BUILDING*

Portland cement concrete (stone mortar) pavement has been used in Berlin only on Grand avenue (Grosser Weg), in the Thiergarten and on Bauhoffstreet, a street with very little traffic in the heart of Berlin.

This pavement was laid by Robert Kieserling, Altona-on-the-Elbe, Viehhofstreet 16, and was put on the market as Kieserling basalt cement stone pavement. This pavement is laid on a foundation of crushed stone; it consists of a lower layer of Kiesbeton about 14 cm. or 15 cm. thick and of an upper layer about 6 cm. thick; the latter, a so-called top or cover layer, is made out of coarse, medium fine and very fine basalt, or granite, together with a cement which has a very peculiar composition, known to the inventor alone. The pavement is made like the asphalt pavement, tamped or pounded from the top.

At distances of 18 meters apart, expansion joints are sunk into the top layer. They consist of parallel cast iron bars 1 cm. apart and adhere permanently to the concrete. The pavement has worn well since 1901 and so far has hardly needed any repairs. However, it is suited to streets with light traffic only, such as the Grosser Weg in the Thiergarten, which is used by carriages and cabs alone, while traffic wagons and automobiles are absolutely prohibited. The pavement, in comparison with others, has many good points; for instance it is durable and noiseless, is very easily kept clean, and above all it is perfectly safe, because its rough surface affords the horses a sure foothold. For this reason it is quite often used as flooring in slaughter houses.

It cannot be recommended for streets with heavy traffic or for such streets as demand the repeated laying of pipes, etc. Heavy traffic loosens the protection at the expansion joints, with consequent rapid destruction of the pavement, while tearing up the hard surface demands much time and labor, and after restoration more than a week is required for the surface to harden up again. This blockades the street too long. An experiment with such pavement in a street with frequent and heavy traffic did not prove a success. On account of too many repairs required in this street the pavement had to be removed after a few years. Concrete pavement mixed with coal tar has not been used in Berlin up to this time.

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[1] This was discussed in *Concrete Engineering* for Mar., 1910. The question of the possible decay of floor sleepers (No. 160) has been discussed further as follows:

Conc. Eng., June, 1910.	Benjamin Fox, Boston, L. P. Sibley, N. Y. C., S. C. Williams, Marion, N. J.
Conc. Eng., July, 1910.	L. P. Sibley, N. Y. C.
Conc. Eng., Sept., 1910.	Editorial, a summary of a report to the Royal Inst. of Brit. Archs.
Conc. Eng., Nov., 1910.	Ian McAlister, London, England

The related question, cited above (No. 178) has been discussed as follows:

Conc. Eng., July, 1910.	Rolf R. Newman, Pasadena, Cal. L. P. Sibley, N. Y. C.
Conc. Eng., Oct., 1910.	Chas. T. Main, Boston L. P. Sibley, N. Y. C.
Cement Age, Sept., 1911.	J. D. Carey, Cleveland
Cement Age, Nov., 1911.	Wilfred E. Griggs, Waterbury, Conn.
Cement Age, Dec., 1911,	Wilfred E. Griggs, Waterbury, Conn.

[2] Pres. Aberthaw Const. Co., Boston

*The discussion by Logan Waller Page under this title in the Dec., 1912, issue prompted editorial inquiry as to the pavement in Germany. This letter is a result of that inquiry. —EDITORS

288. Wrapping I-Beams

"What is the best way of wrapping I-beams with wire or wire mesh to prevent the concrete below the bottom flange from cracking and dropping off?"

288. Discussion by Ira H. Woolson*

In considering the best method of supporting and tying in the concrete used for fireproofing around the bottom flanges of I-beams, the first essential is that there should be a rigid support for the concrete at this point by metal that is held in a fixed position *away from the beam*,[1] and such metal should be of sufficient size to render efficient service even though it should, by some accident, become corroded. It has been the practice of many irresponsible or ignorant contractors in the past to use a light weight metal lath for this purpose. That practice is to be severely condemned. In the first place, the metal being of light weight is likely to be wrapped closely to the flange, leaving little, if any, space for a concrete clinch between it and the beam. If it be loosely wrapped, it will float when the concrete is cast about it, and the results will be practically the same. In the second place, if this light weight metal be attacked by rust and suffer only surface corrosion, the cross-sections of the small strands of metal are materially decreased and the holding power of the fabric dangerously reduced. This is particularly true when 2" of concrete are cast in the under side of girders, as should be done for efficient fireproofing purposes.

The danger of this defective construction is being recognized by intelligent builders, and in well designed buildings the metal used for this purpose is a good respectable reinforcement, in fact, as well as in name. The difficulty of holding such reinforcement at the proper position away from the beam is well recognized, and many attempts have been made to solve it, some of which have been quite successful. Others, like some of those illustrated in the Feb. issue, are either too close to the beam to render efficient service, or else are likely to float when the concrete is being cast. The fireproofing of I-beams is a detail of work which for too long has been relegated to a position of secondary importance. For permanently satisfactory work this detail should receive careful attention.

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*Cons. Engr. Nat'l Bd. of Fire Underwriters, N. Y. C.

[1] The italics are ours. Cf. the discussion under this head in the Feb., 1913, issue.—Editors

* * *

299. Plaster of Paris Molds

"What is the whole procedure in making plaster of Paris molds for concrete casts?"

299. Discussion by Joseph F. Eilbacher*

It requires a thorough knowledge in the workings of plaster of Paris to make plaster molds successfully, and a man without this knowledge will waste considerable costly material in the attempt to use it for this purpose.

The plaster cannot be re-tempered or softened after setting, which will take place in from five min. to 10 min., according to the temperature in the shop.

Then it requires skill to apply the plaster to the model to avoid air-holes, which cost as much time to fill up as the model itself to get satisfactory casts.

After a man has once mastered the peculiarities of plaster of Paris, it is then necessary to figure out the strength of the mold with reinforcements where mostly needed, and this varies with every design and article to be cast from it.

After the mold is really complete made in as many sections as will be required properly to draw the concrete casting, it must be coated with the very best of shellac, but only after it has become absolutely dry.

Proper dowels and sockets must be provided in the mold to keep it in alignment while the wet concrete is being agitated.

An additional casting or jacket must be cast around the base of the mold to keep it in a positive position while making the casting. The mold must be well greased even after it has been shellacked, to prevent the concrete cast from adhering to it.

There are so many details to watch that anyone not accustomed to the use of plaster would make a failure in the attempt. The above is a frank statement and is sincere, for the writer has had some bitter experience with men in his shop who pretended to know, but who could not produce results.

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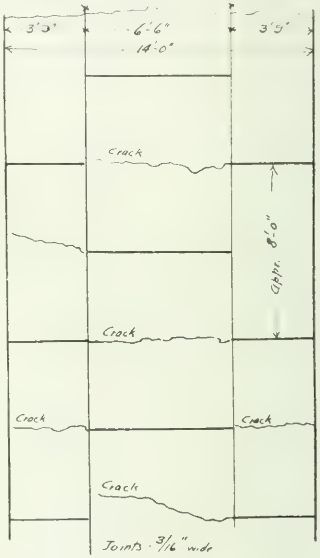
*275 Morris Ave., Philadelphia

* * *

292. Cracks in Concrete Sidewalk

"I am enclosing herewith a sketch showing the jointing plan of a granitoid walk, 14 ft. wide, which I built lately. When the architect showed me this plan, I told him that these joints would crack through the adjoining block, as shown on sketch. He laughed at me. Nevertheless, they did crack through. I have noticed this to happen almost every time. I it caused by expansion or something else?"



Sketch Showing Arrangement of Blocks in Sidewalk

292. Discussion by John McGrath*

In regard to this question, it seems apparent that the workman in charge is undoubtedly more familiar with the working of cement than the architect. This is too often the case. While I have not efficient details, I am convinced that the work was cast in one solid mass, making no allowance for the expansion which would be bound to take place in a walk of such width and of any considerable length. The design would

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*Kansas City, Kans.

Fig 1—Diagram Showing the Grout Knife

The handle should be put on with a loose bolt. If too tight the tamper will jar and cut the bolt. The handle should also be loose, that the knife can be folded for packing.

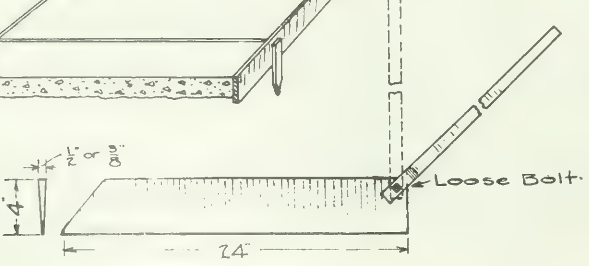
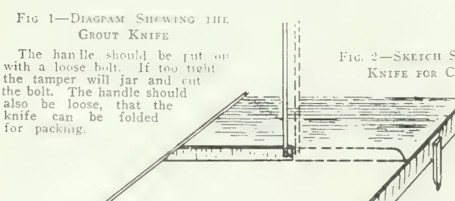


Fig. 2—Sketch Showing the Use of a Grout Knife for Cutting Concrete Walks



have been successfully carried out by building this walk in three separate longitudinal sections, thus making a continuous expansion joint betewen the outer sections and center one. Each transverse expansion joint would also have to be extended to the bottom of the concrete or sub-foundation. Good results can be obtained by cutting cross-joints with a grout knife. This does away with any form that may be necessary to use for making such a joint. It is faster and there is no delay caused by setting a form every block.[1] Great care must be taken to cut the top coat directly over the cut in the concrete base, otherwise the walk itself would show the mistake later on.

The acompanying sketch best explains the grout knife. We use the grout knife immediately after the base concrete has been placed and tamped, and the knife is driven into the sidewalk base with a tamper. The incision, thus made, can be filled with dry sand or closed slightly with a wooden tamper. This keeps the finishing coat from filling the joint made. Great care must be taken to have the side-rails marked as a guide showing where to run the joints. Where 2 x 4's or similar wood forms are used, the safest way to mark the spaces for joints is to cut a small notch on the outside of the form with a pocket knife. Old notches can be easily shaved off. This mark is much better than that made with a pencil which may be rubbed out or smeared.

Grout knives are on sale by the leading houses handling cement workers' supplies or can be made by any blacksmith. The grout knife for the usual run of work is preferably about 2 ft. in length, as this is just right for a 2-ft. sidewalk. As it is only 2′ long, it drives down through the concrete much more easily than if it were longer. Note especially that the sloped nose or point slips down inside the forms without any interference. The blade itself can be made any width. The depth of the average concrete sidewalk is 4″ to 5″, and as the base course is cut before the top coat is put on, a 4-in. blade will cut a 4½ in. or 5 in. slab. The blade ought to be ⅜″ to ½″ at the top and taper to the bottom edge. This doesn't need to be too sharp, just about as sharp as a blacksmith can draw out on an anvil.

The second sketch (Fig. 2), shows the way a knife is used on a 4-ft. walk. A line to guide the knife is made by placing a straight edge across the slab as indicated by the marks on the siderails and scratching the grout with a pointed trowel or similar tool. Note how the knife is reversed to allow the nose to move easily down the side of the form. By having the handle 3 ft. to 4 ft. in length, it can be used by one man, holding the handle perpendicularly with one hand, and using the tamper with the other. The handle can be made any length to suit special conditions.

I have used a grout knife for years and have had no trouble whatever. I have laid sidewalks in nearly every climate in the country. Expansion in concrete is something that a great many contractors overlook in laying out work, but we can not "put anything over" on concrete. It always shows up poor work. As was stated in one issue sometime last year, "concrete is its own inspector." This is a very good slogan. If more people would get that into their heads there probably would be less shoddy work done.

* * *

301.—Wrapping Flue Lining With Paper

"We are planning to build a round concrete chimney, and for the 12′ above the thimble shall use a terra-cotta flue lining. Some one has suggested that the terra-cotta should be wrapped with building paper so that the expansion of the terra-cotta would not crack the concrete. Is this necessary?"

301. Discussion by J. D. Carey.*

I have had no experience in this particular matter but would say the flue lining has done all the expanding it will do. It has been subjected to a great deal more heat in the burning than it ever will be as a chimney flue. Again if the flue became very hot it would transfer the heat to the surounding concrete. We plan arches in locomotives where some pieces measure 3 ft. or more and we do not figure on expansion. Fire bricks are laid up with rubbed joints in boilers, foundries, open hearth and Bessemer furnaces. These are subjected to 2,500° F. to 7,000° F. There is no apparent expansion.

* * *

302. Concrete Top Finish in Compression

"In designing a reinforced concrete floor, under what conditions of construction would the ¾-in. or 1-in. cement mortar top finish be figured as an integral part of the slab and used in compression?"

302. Discussion by F. W. Keyser†

If the finish is run immediately after the concrete and before the latter has developed initial set, the mortar thus deposited will form an integral part of the slab and act together with it in taking the stresses under loading. Very seldom, however, does this meet with the actual conditions on a job; and the designer as a rule has no way by which he can find out whether the finish is placed at the same time as the concrete or run from 3 hrs. to 10 hrs. later. This uncertainty alone should call for caution on the part of the designer in figuring the finish as a part of the slab. I have at times figured the top finish in compression when I knew the superintendent on the job to be a careful man; never, however, without putting an underscored note on the drawing to the effect that the finish should be run immediately after concrete was run. For a winter job I would not advise figuring this way under any circumstances.

* * *

303. Concrete Septic Tanks for Sewage Disposal

Will a tank such as described in the Sept., 1912, issue,[1] require a filter, or, as I believe it is technically called, a "contact-bed?" As I understand it, a septic tank is a dark chamber, hermetically sealed from the air by its own contents, in which certain bacteria, technically called "anaerobic bacteria," are generated, liquefying and destroying the solids in the sewage. Now according to the article in the Sept. number, I would suppose the first or charge tank is the one in which the anaerobic bacteria are generated. Is the second the one in which the aerobic bacteria are generated? If so, does the water come out sufficiently pure, clear and free from contamination to be discharged into a pond?

Applying the design as illustrated in the Sept. number, may I have more information on the following points: I am planning to build a tank for 400 persons, to be 40′ x 20′, 4′ deep, with two tanks.

1st. Would such a plant require any attention other than cleaning once every two or three years?

2nd. Would this suggested design be all right with a 4-in. concrete roof, reinforced with 90-lb. steel rails, 21′ long placed every 10′ transversely, and the slab reinforced with ½-in. rods either way, 8″ o. c. All concrete 1:2:2½.

3rd. Could a man guarantee such a plant to discharge clear water free from offensive odor (without filtering)?

4th. Would the second tank need to have a lot of air holes in the second compartments?

5th. This plant at present will be used for only 180-225 people. I have heard that a tank larger than is immediately needed will not work well. Can you furnish any information?

6th. Is this tank built according to the Cameron patent for septic tanks?

303. Discussion by A. Marston *

I would say that a competent sanitary engineer should be employed to design any septic tank for the disposal of sewage of 400 persons. The matter is entirely too intricate to be discussed adequately in correspondence.

Recent improvements in the designs of sewage tanks have made important changes in the best practice in a general way. I am answering the questions cited above as follows:

1st. It is not true that such a plant would not require any attention other than cleaning once every two or three years. It should be cleaned every few months, and, moreover, the tank alone will not ordinarily produce sewage satisfactorily without the addition of proper filters.

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[1] This is not an objection, in several forms on the market.—Editors

*Concrete Contractor, Cleveland

†New Haven, Conn.

[1] "Sewage Disposal for Country Homes with Concrete Septic Tanks," p. 62, Sept., 1912.

*Dean, Eng. Div., Iowa State College, Ames, Ia.

2nd. I could not pass on the details of the design of this tank at a distance, and without seeing any of the plans.

3rd. Most certainly such a plant could not be guaranteed to discharge clear water free from offensive odor, without filtering.

4th, 5th, and 6th. Not having the plans of this tank at hand, I could not answer these questions.

* * *

304. Panama Canal Information

"How many bbls. of cement will have been required to complete the Panama canal structure?

"How many cu. yds. of concrete will there be in the finished structure?

"What is the widest, longest, and highest section of concrete?

"Is it the largest concrete job that has ever been projected?

"What will be the cost per yd. of concrete, placed?"

304. Discussion by Joseph Bucklin Bishop.*

Relative to the cement used and the concrete work on the Panama canal, I submit the following:

The estimated total number of cu. yds. of concrete embraced in the following items, is:

Locks	4,365,200	cu. yds.
Dams	302,100	" "
Docks and sea walls	371,000	" "
Total estimated	5,038,300	" "

There had been placed, up to Dec. 1, 1912:

Locks	4,095,232	cu. yds.
Dams	210,635	" "
Docks and sea walls	404	" "
Total placed	4,306,271	" "

The 4,095,232 cu. yds. of concrete in the locks have consumed 4,306,381 bbls. of cement, and the 209,153 cu. yds. of concrete in Gatun dam have consumed 218,110 barrels. A very large amount of cement has been used for water-works, paving, buildings, and other structures.

The average cost to Dec. 1, 1912, of concrete in the locks has been, including "general administration" and "plant," about $6.40 per cu. yd. This includes both "plain" and "reinforced" concrete.

The center wall at Gatun locks, not including the cellular approach walls, is 60′ wide, 80′ high, and 4,060′ long.

The new edition of the Official Handbook of the Panama Canal Commission contains complete information on the dimensions of the locks, dams, spillways, etc.

305. Colored Mortar For Stucco and Plaster

"As a low-cost interior finish, would it be practical to mix one of these prepared 'cold water' paints with the mortar? Could mortar colors be used? Would this be applicable to stucco?"

305. Discussion by C. R. Knapp.*

Relative to the question of putting coloring matter into the plaster mortar in low cost concrete cottages—this is possible, but I would not advise it, as the cost would be higher than putting the coloring matter on the finished wall in the shape of a cold water paint. In the first place, a great deal of attention and work would be caused by trying to gauge the color so that there would be no dark and no light spots. If any patching had to be done in the final finishing, it could not be done without showing. Where we put the coloring on in form of water paint, we have none of the disadvantages, and spots may be retouched with ease.

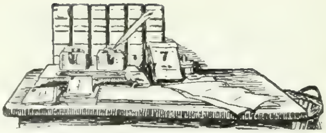
Robert W. Lesley, consulting editor of Concrete-Cement Age, was signally honored recently by the Association of German Portland Cement manufacturers. A special invitation was sent him to attend the annual meeting of the Association in Berlin, Feb. 10-12 last. Dr. Muller, who sends the invitation, adds a personal note that it would give the members pleasure to see Mr. Lesley personally and to thank him for the many courtesies extended to them at the recent Congress of the International Society for Testing Mateerials, held in New York.

Gray & Davis, makers of automobile lighting and starting systems, are to have a new building, which is being designed by Monks & Johnson, Engs. and archts., Boston. The building will be in Cambridge, Mass., facing the Charles river and Boston.

It will be built entirely of reinforced concrete, with steel sash and tapestry brick facing. The main structure will be 381′ 6″ long by 81′ 0″ wide on the first floor and 61′ 0″ wide above that, and will be five stories high. Foundations are now being placed, and it is expected that the building will be ready for occupancy about July 1, 1913.

The Williams Contractors' Supply Co., Brunson Bldg., Columbus, O., has taken the agency for the "Chain Belt" mixer, hoists, spouts, and other concrete machinery made by the Chain Belt Co., Milwaukee. The Williams Co. carries a complete line of rock crushing, earth moving, and street-cleaning machinery. The "Chain Belt" mixer will be handled by the company in the western part of Ohio, Kentucky and West Virginia.

According to the N. Y. C. building regulations, the steel reinforcement in columns and girders shall be protected by a minimum of 2″ of concrete; in beams and walls by a minimum of 1½″; and in floor slabs by a minimum of 1″ of concrete.



CORRESPONDENCE

The Year in Concrete Home-building

In summing up the development in concrete house building for 1912, the general public interest and public demand for more permanent and fireproof houses is perhaps the most encouraging point of progress. The demand for better houses must come from the people. Progress in architecture, engineering or even science is dependent upon public demand, and while there may be exceptions to the rule, generally the art, architecture or construction of any period represents directly the public education and demand. Each decadent period in the world's history is clearly marked in its architecture; we are coming to realize that the frame dwelling is frightfully expensive when the endless repairs, paint, insurance, early decay and fire loss in lives and property are considered.

A few years ago the wealthy man built his house of frame, although large collections of priceless value were housed therein. Today he builds of better material. Our workmen's houses were formerly of frame, as it was considered the least expensive method of building.

The writer while lately abroad in Paris, inspected a group of convenient two-room apartments with outside porches, toilets and plumbing, renting for four francs or 80 cts. per week, yet affording a fair return on the investment. The reason for this exceptionally low rental was at once apparent; the building was of reinforced concrete throughout. The first cost was practically the only cost and the house was *good for a thousand years.* This is the real low-cost home for the wage-earner.

Permanency has been offered as an objection to concrete houses in America. Owing to the rapid growth of our cities, re-building or alteration every 10 years has been the order. Is not this a wasteful practice? What would be our opinion of a manufacturing concern which would build today with the expectation of destroying the entire plant, and re-building 10 years hence? Why should our cities be rebuilt so often?

Into this problem the city planner must enter, and so lay out the plan that such waste will be eliminated. The ideal city of tomorrow will be laid out for growth, on an ambitious and comprehensive plan. It may be possible and probable that it will take a century for such settlements or hamlets to grow to the point anticipated, yet we must build and plan for the future. We must build permanent indestructible cities with broad streets and parks, carefully laid out and studied from the engineering, architectural and landscape standpoint, and constructed of no less permanent material than concrete.

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*Sec. Isthmian Canal Commission, Ancon, C. Z.

*Concrete House Builder, Albany, N. Y.

The progressive architect of today is studying logical concrete design, and the results of 1912 indicate that this is no small factor in our progress.

Milton Dana Morrill.

Read & Morrill,
Brooklyn, N. Y.

* * *

Spraying Concrete Block, Face Up

In the treatment of the surface of concrete stone with spray, we have found that when using granite facing we get the best results when the surface to be treated is turned up so that the surface lies in a horizontal plane instead of a vertical. In this way we have found that water from the spray, after taking away the film of cement from the surface, runs down into the block carrying the cement to the base of the facing aggregate, giving a much stronger bond. We find that this also gives additional density in the face, resulting in a more nearly waterproof product. If this spraying is done with the face vertical, the water runs off, carrying the cement with it, leaving the face streaked, or at least washing the face deeper at the top than at the bottom where some of the surplus cement is deposited on the way down.

J. M. Gifford.

Bishop & Gifford,
Baldwin, L. I.

* * *

Concrete Houses at Low Rentals

The Modern Homes Co., Youngstown, O., was organized for the purpose of building modern sanitary fireproof homes to rent to workingmen, at the lowest rent possible. Since June, 1910, they have erected enough buildings to house 110 families.[1] These buildings are so grouped that they face a park containing about three acres, with plenty of large shade trees, shrubbery and grass. The buildings are of various sizes to meet the demands of the size of the family (congestion in the homes is not permitted); they contain three rooms, four rooms, five rooms, six rooms and seven rooms. Bathrooms are in addition to the number of rooms named, and even the three-room apartments have bathrooms. Cellars are built under each building, the water rent is paid by the Modern Homes Co.; and rents are $10, $12, $16, $20, $22, $25, depending on the type of dwelling. An evidence of the popularity of these homes is that they are rarely vacant, and the waiting list for any vacancies is always large.

The foregoing is a brief summary of the work performed in a period of two years and seven months:

To summarize the operations of the past year, we may say that the work has been along the lines of a somewhat better type of construction from interior as well as exterior treatment while our principal structural unit is still hollow concrete tile. Experience and considerable thought have enabled us to introduce certain innovations, which we have reason to believe are highly beneficial. For example, a system of ventilating, completely removing the vitiated air from every room and clothes closet in the house, has proven a decided success. People are careless; a good many of them think that to open doors or windows in low temperature weather, is a waste of heat, and we have adopted this means of eliminating the impure air.

In some of the buildings we have introduced the sleeping porch feature, with copper screens for summer and sliding glass sash, to be put in when screens are taken out. This sleeping porch, we believe will be of great benefit to our tenants. It is not a common practice among landlords (especially of the moderate rent type of house), to add them to their houses.

The buildings erected within the past year have 8-ft. ceilings in cellars. This is a great improvement over 7-ft. ceilings, and means better light and ventilation and greater efficiency of the hot air furnace. This last advantage is because the pipes have a greater elevation, and the hot air travels more easily to the upper parts of the building, not remaining in the basement, as it usually does to a certain extent in the lower ceilinged cellars.

G. E. Huggins.

Sec. and Mgr. The Modern Homes Co., Youngstown, O.

Painting Structural Steel Frame[1]

On our work we have used structural steel columns a number of times, supporting the reinforced concrete floors on shelf angles. The columns were encased solidly in concrete, with 2″ of protection over their most exposed parts. In the majority of cases of this character no painting whatsoever has been used and we consider this first-class construction, provided steel is encased before it begins to rust badly and especially before any scale rust forms.

More than 10 years ago we made some experiments embedding rusty bars in concrete, and after a period of about a month broke them open to see the condition of the steel. Wherever there had been hard rust without scale and the cement was in hard contact with the steel, it had become bright. Part of the same test were specimens where the steel was embedded with 2″ of protection and immersed in water up to seven or eight years. Where the cement was in hard contact with the steel after this length of immersion the bars were invariably bright, but where there was a hollow space the bars had rusted and the ends of the bars which projected beyond the surface of the concrete had in several cases almost completely worn away.

Leonard C. Wason.

Pres. Aberthaw Cons. Co.,
Boston.

Relative to the necessity of painting structural steel, it is our practice, when the steel is encased in concrete and forms part of the reinforced concrete construction, not to paint the steel work with an oil paint. We depend on the concrete to protect the steel work after it is encased. In fact, experience has shown that a dense mixture of Portland cement concrete makes a thorough protection for steel work against rusting.

Emile G. Perrot.

Ballinger & Perrot, Architects,
Philadelphia.

* * *

Time Record in Building

In recent issues of Concrete-Cement Age I have been very much interested in noting the correspondence as to time records in putting up concrete buildings. In the construction of the Fisher build-

Low-Rental Homes for Workingmen at Youngstown
The houses face an open park, making a big front yard. The only streets serving the group are a narrow alley-way down the rear of each of the houses

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[1] In the July, 1910, issue of *Concrete*, the design and construction features of this development are described in detail

[1] Cf. editorial comment on this question, p. [illegible], Jan., 1913, issue

ing, Detroit, details of which were covered in the Feb., 1913, issue, records were made which should add some light to the data on the subject. It will be remembered from the description in the February issue that the construction here is a combination of tile and concrete floors, flat reinforced concrete girders, and structural steel columns.

The first floor was finished Aug. 15, and the ninth floor, or rather the roof was finished Oct. 19. This makes a gross total of 65 days. From this we should deduct nine Sundays, and two holidays (Labor-Day and Cadillaqua, a fête day). This gives a net of 54 days, which means an average of 6¾ days to each floor. In this calculation we have not considered four rainy days upon which no work was done.

The structural steel columns were set by the general contractors, Bryant & Detwiler Co., Detroit. The following is a detailed schedule of operation:

Aug. 15, finished first floor and started on second.
Aug. 27, finished second floor.
Sep. 9, finished third floor.
Sep. 17, finished fourth floor.
Sep. 24, finished fifth floor.
Sep. 30, finished sixth floor.
Oct. 7, finished seventh floor.
Oct. 12, finished eighth floor.
Oct. 19, finished ninth floor, or roof.

The delay between Aug. 27 and Sept. 9 was due to non-arrival of material. The area of a floor 60' x 100' is 6,000 sq. ft. and the run for a single floor requires about 200 cu. yds. of concrete and about 3,000 tile.

JOHN MCMICHAEL.
Detroit, Michigan.

* * *

Hollow Concrete Tile

Referring to a paragraph in an article[1] by Osward C. Hering, on concrete hollow tile, which touches on the furring of structures built from these tile, I desire to state that our experience (in a period of two years and seven months) in the construction of 110 buildings, ranging in cost from $1,000 to $5,000, has demonstrated that it is *not essential* to go to the expense of furring the interior walls to prevent dampness.[2]

G. E. HUGGINS.
Secy-Mgr. Modern Homes Co.

* * *

Oxy-Chloride Cement Formulas

Oxy-chloride cements are formed by the chemical union of magnesite, the commercial form of magnesia, with chloride of magnesium, to form an oxy-chloride cement of magnesia expressed by the formula $1MgCl_2\ 5MgO+17H_2O$. Magnesite comes principally from the island of Euboea, in Greece; it is burned at the mines, transported to the mills at Amsterdam, Holland, there ground and barreled and shipped to this country. The chloride is a bi-product of the Kali Syndicate of Stassfurt-Leopoldshal, Germany, producers of fertilizers.

In 1866, Stanislas Sorel, a French engineer, patented this composition in this country and about the same time patented the cement much used by dentists, which is of a nature similar to the oxy-chloride cement of magnesia, but having zinc as its base. This Sorel stone, as it was formerly called, has found a large use in Germany and elsewhere in Europe, principally for laying sanitary floors, counter tops and for steamship decks. Owing to the humidity of the atmosphere in Europe, the material hardens much more slowly than it generally does in this country, and on account of cheap labor conditions a much finer floor can be built there than here. This slow hardening or setting is a desirable feature of this material; the chemical reaction taking place slowly through a period of say 24 hrs. is much preferable to a quick set. For instance, I have had floors that set in a half hour's time, I have also had floors in which the chemical action took place so rapidly as to produce extreme heat, sufficient to burn one's hand. If it were possible to procure pure magnesium oxide and pure chloride of magnesium in all probability the average mechanic could secure a relaible product in almost every instance. The commercial chloride, however, is a waste or bi-product, hence no guarantee is had that it is pure; the magnesite is also a substitute for the pure magnesia. Magnesite has an affinity for the CO_2 gases in the air and if any uncombined or free magnesite exists in a floor it will in time take up this gas and cracking of the floor will result. Lime will also cause floors to crack, hence plaster or other lime products must be carefully removed from any surface to be covered if a lasting product is desired. A surplus of the chloride will show up on the drying out of the product as a salty white deposit on the surface of the material when placed. A deficiency in the amount of the chloride used will leave uncombined magnesite in the completed article, with its tendency to absorb carbon dioxide from the air and cause cracking. Because the two chemicals are of varying degrees of purity, it is very difficult for the manufacturer to be sure in each instance that his product will be uniform; the same formula will not always work the same. Temperature conditions are another very hard feature to combat. The general result is that failures are more or less common, depending, of course, upon the experience and expert knowledge of the workman or manufacturer. This material has been very extensively used by the transatlantic steamship lines for deck coverings. All Pullman cars are floored with this material, and many other railroad coaches have floors of this material both in this country and abroad. The N. Y. C. subway cars, the Erie terminals, etc., have these floors and great quantities are used in hospitals and other buildings.

From time to time new firms spring up and so-called engineers discover the wonderful processes by which the forests of Arizona were petrified or the pyramids of Egypt erected; they "spring" it on the public for a few months, "get theirs" and then disappear. I know of at least 20 concerns, and have in my office a number of prospectuses of such, who made a flying start with this material and who are not in the business today. It is not always because they are dishonest or incapable of producing a good article; a great majority of them were good honest contractors who found that the cost of production and unavoidable bad jobs prevented them making as large profits as they felt their time and attention would give them in other lines of endeavor.

This material is being boosted as a very desirable material for outside uses such as stucco. The cost of the chloride and magnesite, due to heavy duties payable to our government and the cost of transportation, etc., preclude its use for such purposes even if it were chemically adapted for them. Different fillers are employed for such stucco work and the claim is sometimes made by manufacturers of such articles that the binding is not formed by the oxy-chloride cement of magnesia, but by other agencies. Some say they use oil to produce the set, being very secretive as to the oil used. Chloride of magnesium is oily in appearance and to the touch, and is the only agency that will produce such cement with the magnesite; any other fluid is used only as a blind to change the chemical constituency of the article for a possible analysis. Oil is often used to assist in the troweling, also to waterproof the product and to hold up the brightness of the coloring matter used in the mix.

In Europe most of the floors are scraped, like hardwood floors, when in a cheesy state, later on finished by polishing, then oiled or waxed; this produces a very beautiful "Steinholz" floor. I am acquainted with formulas and work of about 20 European concerns, having visited them and seen much of their work. They attempt on the whole much more elaborate work than is usually done by the manufacturers in this country, since their labor and materials are more cheaply obtained. Very artistic marble or terrazzo effects are obtained and if kept oiled or waxed such floors will wear and look well indefinitely. I have laid such floors in banks and court houses in this territory with good success, due to the fact that their janitors properly attended to such waxing and oiling.

The use of this material for outside work has never reached a point where it can be considered a success. In Sorel's time the French government tried this cement for dock and quay uses, but it would not stand the elements so well as Portland. It was thought for a time that it was better and that it would stand the action of sea water to better advantage than the Portland cement products, but this has not proved true. I have porch floors that have been down seven years that are standing up well, but they are partially covered. I would not recommend the use of this material as a stucco finish no matter what filler were used, first because the cost is too great, and secondly, because the product will undoubtedly crack in time.

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[1] Feb., 1913, issue, p. 66.

[2] Our correspondent refers here to "Parity" concrete tile, which his company has used.—Editor.

Sash and door companies have endeavored from time to time to use this material for doors, etc., but it has not been a success. In the first place this cement is much stronger than Portland and has much greater adhering and bonding properties; it also has an inherent tendency to expand and must be rigidly bonded to a firm support or it will warp. For this reason most manufacturers reinforce their floors. I have seen doors that were warped all out of shape and floors that have raised up a foot in height. I have seen stone walls pushed out of plumb by the expansion of the floors and also columns and copings buckled. In my own work, however, I did not have such dire results because I laid all work in sections, permitting the expansion to take place before the work was fully completed. I am frank to say that I think it an impossibility for any concern to mix up a quantity of this material and ship to an inexperienced person for use. It requires an expert on the job all the time to meet the various problems that invariably seem to follow its use. A good practical man will in time learn to use this material to advantage and if he sticks to the actual work of laying it he will meet with success, but let him leave it to others to do and he will pay the penalty.

Various attempts have been made to produce this oxy-chloride cement of magnesia by other chemicals, so that a more reliable work might be produced. In Germany a product called "Abel's Masse" is found, the mere addition of water to the mix at the job resulting in the formation of this cement. In this country a similar patented product is found in which barium chloride, magnesium sulphate (Epsom salts), and magnesite are employed. As the barium chloride is a drier product than magnesium chloride, it does not furnish any water of itself so that a dry mix can be made and water added to the mix at the job. The following action then takes place: the chloride from the barium chloride combines with the magnesium from the magnesium sulphate to produce magnesium chloride; the barium and the sulphate form barium sulphate, and the magnesite then combines with the formed magnesium chloride to form the oxy-chloride cement of magnesia. Dolomite is also used in place of the magnesite. However, this material has its objections and is not commercially employed.

I have never tried to capitalize my experience with this material in any other way than in the actual laying of the product and have no patience with promoters who try to "put their product over" as something different, as not being an oxy-chloride cement of magnesia. Anyone can get the chloride taste by sucking any sample of such material. Any contractor who is laying good floors of this material deserves his success because he has worked hard and endeavored to perfect his own knowledge of the action of the material under different conditions. I venture to state that not one of them would honestly say he could pass his knowledge to someone else; it is like swimming or bicycle riding, the individual must learn the game himself. To any who think this material is new because some promoter says so, I will say that he can get a very good grounding in the first principles of the game and save himself a lot of future grief and tribulation by getting a copy of the Sorel patent, or by buying a copy of Edwin C. Eckel's "Cements, Limes and Plasters."

W. C. Edwards, Jr., C. E.
Kansas City, Mo.

How to Build Concrete Wind Break Fences

Formerly stockmen and dairymen used high stone fences and dense hedges to shield their exercise-lots from wintry blasts. Since such wind-walls have objectionable features, and are also not everywhere possible, many farmers are now building their wind-breaks of concrete.

Begin constructing the wind-break on that side of the exercise-lot from which the winter winds most often blow. A very convenient way to build the wall is in panel sections 12′ long, 6′ high and 6″ thick, with a foundation 1′ thick and extending 3′ into the ground. Supporting one end of this panel, and built at the same time, is a large concrete post 1′ x 1′, 6′ above ground and 4′ below. The other end of the panel is keyed into the mortise in a similar large post molded at the previous operation, as shown in drawing below.

The forms for the panel are simply two independent walls of 1-in. siding on 2-in. x 4-in. uprights 6′ long and spaced 2′ apart. The mold for the post is merely a 6-ft. box 12″ x 12″ on the inside and open on one face and both ends. It is made of 2-in. lumber. The open side butts against the end 2-in. x 4-in. uprights of the panel forms. To the inside of the board opposite this open face is nailed the wedge-shaped timber which forms the mortise lengthwise the post into which the next panel is keyed. For this wedge-shaped timber use a 3-in. x 4-in. piece, with the 4-in. dimension nailed to the form and the sides beveled to produce a 3-in. face. Through this beveled piece, 3″ from the top and bottom, bore two ⅝-in. holes in which 2-ft. lengths of ⅜-in. rods are placed and allowed to project 1′ into the next panel.

Using the post mold only, build the end or corner post of the wind-break and, if necessary, make an extra mortise in it. Dig the hole 12″ x 12″ and 4′ deep. Set up the post form, plumb it carefully with a carpenter's level and fill with mushy wet concrete. Proportion the concrete 1 bag of Portland cement to 4 cu. ft. of pit gravel, or 1 bag of cement to 2 cu. ft. of sand and 4 cu. ft. of crushed rock. Reinforce the post, 1½″ from each corner, with a ⅜-in. rod, 9′ long. Wire these rods securely together, diagonally, near the top. Remember to insert the short lengths of rods which tie the post to the next panel. In warm weather the post form (as well as that for the panel) may be removed in three days. Then dig the next 4-ft. post hole and 3-ft. panel trench. Fill them with concrete and immediately set up the post and panel forms with the latter butting against the last-made concrete post. Reinforce the post as before and also the panel, 3″ from the top and the bottom and halfway up the wall, with two ⅜-in. bars equally spaced from each other and the sides of the form. Labor of lifting the concrete can be lightened by slipping the boards in place on one side of the panel form as they are needed. Build section after section until the wind-break is

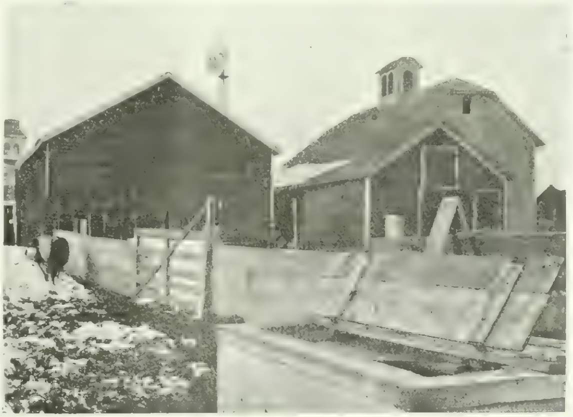
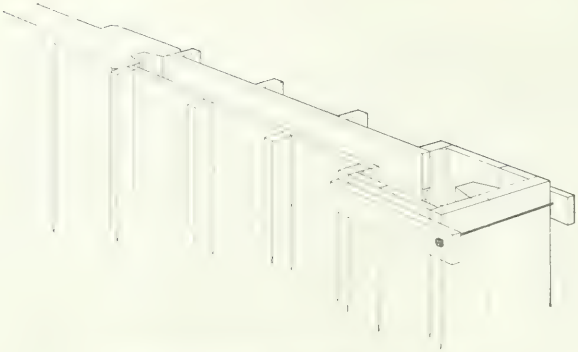


Fig. 1—Concrete Wind Break Fence and Watering Tank



[illegible] New Form Above; Form Abutting Finished Post

completed. Keep animals away from the wind-break until it is two weeks old.

For one section of panel and post, 12′ 9″ over all, there will be required 5 bbls. of Portland cement, 1½ cu. yds. of sand, 3 cu. yds. of crushed rock and 10 pieces of ⅜-in. x 12 ft. steel reinforcement bars. The cost of these materials is about $12.00 for the average locality. The same general plan is adaptable to building ornamental garden walls.

Concrete in Bungalow, Chapel and Workshop

The accompanying illustrations show some interesting work in concrete construction and they are presented here because the work is unusual rather than typical. It was done by A. P. Greim, Cedar Brook, N. J., manufacturer of rustic ware. He has been much interested in the ornate possibilities of concrete and has made numerous experiments in that line.

In Fig. 1 is shown a corner of a concrete "chapel" with vaulted ceiling and ornamentation in clay tiles. The columns are solid concrete as is also the ceiling. The work was planned by Mr. Greim and carried out by him with the assistance of one helper. No cracks have developed to indicate any structural flaw.

Fig. 2 shows a bungalow built entirely of concrete, with concrete block walls. Fig. 3 is a front view of Mr. Greim's workshop, showing belfry and trademark over entrance, the latter in colored concrete.

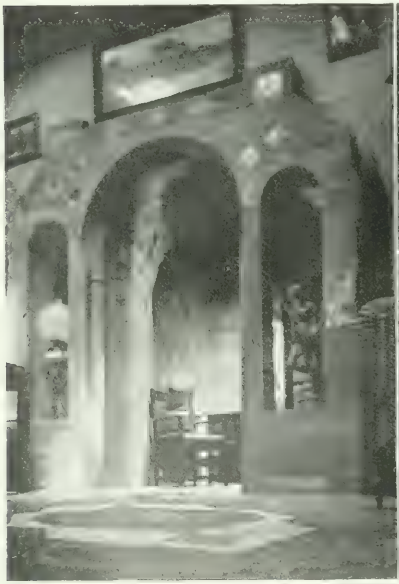
Floating Concrete Buoys in Jamaica

Reinforced concrete in boat and barge construction is rapidly becoming an established fact. To use concrete in buoy construction is a new application meriting more than passing attention. In the accompanying illustrations, Fig. 1 (above) shows a buoy under construction, and (below) the buoy being launched.

The buoys are cylindrical, the bottom being concave like a champagne bottle, thus affording protection for the eyebolt to which the mooring chain is attached. The sides are built up of curved ribbed steel mesh, "Hy-Rib,"[1] the ribs running horizontally. The reinforcing bars in the bottom are bent so as to be carried up on the inside of the mesh shell. The top is a solid slab, the reinforcement being carried down the sides so as to provide a suitable bond. The sides are plastered inside and out to a total thickness of 3″, and the completed buoys weigh about five tons each.

A temporary manhole is left in the top for the removal of the interior centering, and also for convenience in lowering the buoy into the water. There is also an interior eyebolt at the apex of the bottom into which a tackle may be hooked for handling purposes. After the buoy is once placed in the water the cover of the manhole is grouted into place and may be swabbed over with hot bituminous cement to make assurance doubly sure.

A small pump hole fitted with a brass screw cap is also provided in the top, as the buoys sometimes leak a trifle for the first few days, after which,



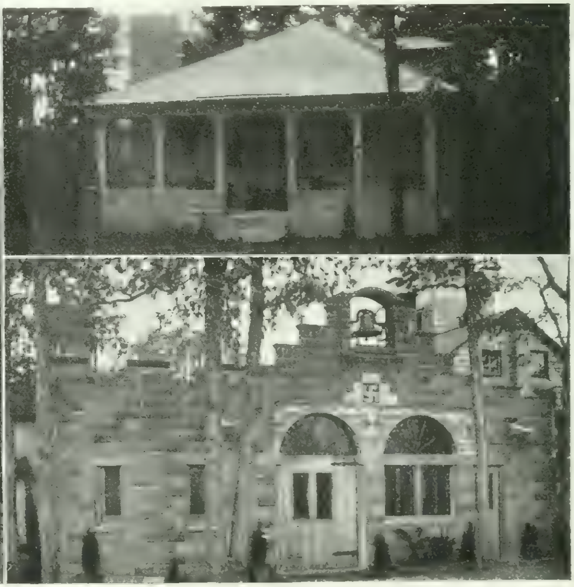
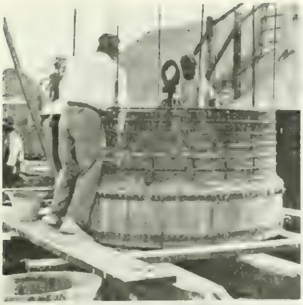


Fig. 2 and (below) Fig. 3



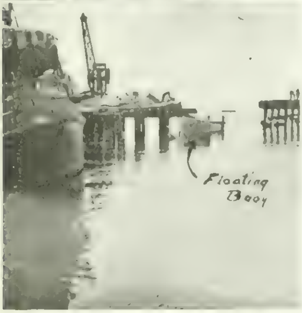


Fig. 1—Above: A Concrete Buoy Under Construction

Fig. 2—Below: Launching a Concrete Buoy at Kingston, Jamaica

however, they seem to remain absolutely dry inside. The concrete and cement plaster is waterproofed with a waterproofing paste in the usual manner.

The engineers were somewhat surprised to find that it was necessary to place about a ton of ballast in the bottom of each buoy in order to hold it down low enough in the water to make it ride properly.

The cost of these buoys was very much less than the standard steel buoys which had heretofore been used, the latter costing about $365 c. i. f. Kingston, whereas the reinforced concrete buoys, including eyebolts and everything, cost about $170. The engineers, moreover, expect to eliminate all upkeep expense, which has been considerable in the case of steel buoys.

Axial compression in columns without hoops, bands or spirals, and with not less than ½% nor more than 4% of vertical reinforcement secured against lateral displacement by steel ties placed not farther apart than 15 diameters of the rods nor more than 12", shall not exceed 500 lbs. per sq. in. on the concrete nor 6,000 lbs. per sq. in. on the vertical reinforcement.—*N. Y. C. Bldg. Regulations.*

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[1] Trussed Concrete Steel Co., Detroit

Manufacture of Concrete Products in Germany[*]

BY JULIUS CARSTANJEN, JR.[†]

The artificial stone industry in Germany, which depended on the development of the cement industry, can be traced back for about 50 years. The cement which was employed at that time was quick-setting, which made it possible to use the forms repeatedly, at short intervals. The method of manufacture consisted of casting the concrete, of very wet consistency, in wood and plaster forms. All kinds of architectural and ornamental stone have been made in this manner. The surface, however, appeared flat but soon one began to wash it off with water or treat it with acid whereby the different grains of sand became visible and the stone itself more animated. In the use of quick-setting cement, however, there was danger of hair-cracks which gave the stone a poor and unfinished surface. This especially caused many objections by the laymen.

Further development of the Portland cement industry brought about a change in manufacture. In place of wet concrete, one of rather dry consistency was adopted, and is in use to-day, being well tamped into the iron, wood, plaster or glue forms. By mixing with the concrete good weatherproof mineral colors, all imaginable shades can be obtained to meet the requirements of the architect. This led to the use of a facing of rather rich concrete containing fine aggregate only, backed up by a coarse concrete. Colored stone manufactured in this manner, remains as it comes from the form, or else is washed off or treated with acid.

At the end of the last century a further improvement in the production of artificial stone took place, the device of tooling the surface. There can be no doubt that this gives stone more life. This leads to another very important point, which is the use of the colored aggregate. This is accomplished by mixing with the facing an aggregate having the color of the natural stone it is desired to reproduce, making possible the manufacture of an artificial stone which cannot be distinguished from natural stone.

Very much depends, of course, on the use of the proper aggregates, correctly proportioned both as to size and mixture. It is best to use a machine mixer. Tamping the concrete in the forms is done with the proper tools, either by hand or compressed air, resulting in a perfectly dense product. The facing is about 1" in thickness and the backing is of coarse concrete.

After the stone is removed from the form, which is generally by turning it over in sand immediately after the tamping, it is kept wet and is ready for the stone cutter after 10 to 14 days. The stone, of course, can be reinforced as desired and also be ground and polished, as is customary for risers, wainscoting, etc.

The same surface effects can be obtained in reinforced concrete work. In erecting, let us say, an artistic portal, a concrete facing is used. This fine concrete facing is first tamped in the casing in the customary thickness of 1", and by properly tamping the coarse concrete is combined with it and the proper aggregates for the facing give the surface the desired tone, requiring only the work of the stone cutter on removal of the form.

The accompanying illustrations will give some idea of the methods of manufacture in Germany:

Fig. 1 shows a carpenter shop in which most of the wood forms are prepared except those of more complicated profiles.

Fig. 2 shows a modeling room used principally for plaster and glue forms. In the background are a few large models of figures.

Fig. 3 shows the casting floor where, it will be noticed, the concrete is being tamped by pneumatic tampers. The set of forms in the foreground will illustrate the method of construction.

Fig. 4 shows the storage of artificial stone awaiting the hand of the stone cutter, while in Fig. 5 is shown a fountain and in Fig. 6 the stone cutter is at work on sections of a concrete fountain. In order to reduce the weight the individual sections are made hollow.

Artificial Stone

Some recent very interesting work in artificial stone was done by the firm of E. Schwenk, Ulm on the Danube, one of the most prominent firms manufacturing artificial stone. One of their undertakings was the restoration of the Konigsbau (Kings Building) at Stuttgart, erected by King William I of Wurtemberg, ornamented by a long row of Doric and Corinthian columns of fine sandstone, erected about 50 years ago. (Fig. 7.)

Fig. 8 shows the lower part of one of the columns and it will be noted how the sandstone has been affected by the weather and partially destroyed. The places where the sandstone has chipped off are at a height about the level of the eye of the passer-by. The sandstone itself was quarried in the neighborhood of Stuttgart. The two other corners (note at *a*) illustrate how the officials in charge of the building endeavored to repair the worst places with cement. This, however, did not stop the deterioration of the other parts of the sandstone.

In order to preserve the beauty of the building and to insure its permanence the authorities found it necessary to take radical steps which resulted in replacing the damaged sandstone bases with artificial stone of the same contours.

Fig. 9 shows the method of removing part of the sandstone column bases,

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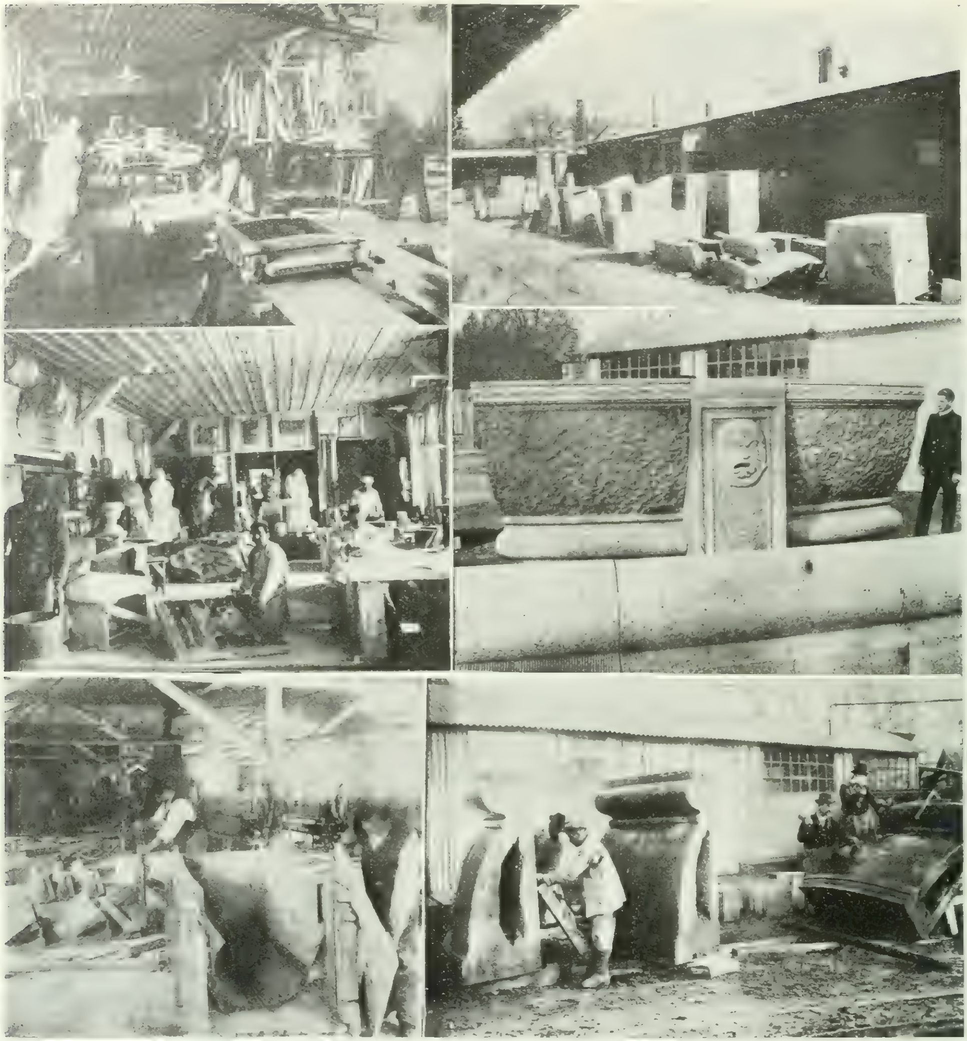
[*] Presented at the Ninth Annual Convention, N. A. C. U.

[†] Duisburger Cementwaren Fabrik, Carstanjen and Company, Duisburg, Germany.



FIGS. 1, 2, 3 (TOP TO BOTTOM) AND (AT THE RIGHT, TOP TO BOTTOM) FIGS. 4, 5 AND 6—THE FIRST THREE VIEWS BEING OF A GERMAN CONCRETE PRODUCTS FACTORY, FIG. 4 A STORAGE YARD; FIG. 5 A FOUNTAIN MADE OF FACTORY-CAST UNITS AND FIG. 6 SHOWS MEN TOOLING THESE FOUNTAIN SECTIONS

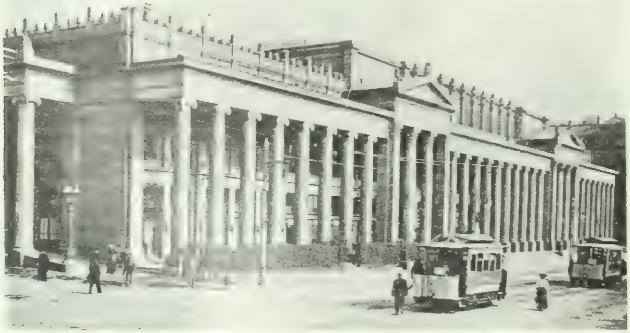


FIG. 7—DISINTEGRATING STONE COLUMNS OF GERMAN BUILDING RESTORED WITH CONCRETE

which are then replaced by concrete blocks. Evidence of the justification of replacing sandstone with artificial concrete stone is given by the fact that work two years old is in perfect condition. The manufacturer of the artificial stone was able to match so closely the color and texture of the sandstone that one can hardly note the difference. The artificial stone sections of the new concrete block column bases will also be noticed. The fresh joints are distinctly visible in Fig. 10, which also gives an idea of the number of columns thus repaired.

Another work of restoration was that of the statuary on the Royal Palace at Stuttgart, finished about 1750 by the splendor-loving Duke Karl of Wurtemberg. The rich balustrade of artistic statuary, which is in almost double life size, is of sandstone. (Fig. 11.) A number of years ago these sandstone figures were replaced one by one by statuary of the best kinds of natural stone, such as the famous Kehlheimer and other excellent stones, but at the present time these are also in need of renovation. See Fig. 12, which also illustrates the method of copper wiring used to prevent single parts, such as arms, hands, etc., from falling off and injuring people below. The danger was so great that this method had to be adopted, although it did not add to the beauty of the statuary and in spite of all precautions small pieces constantly fell.

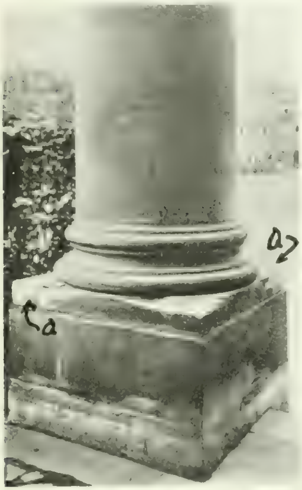
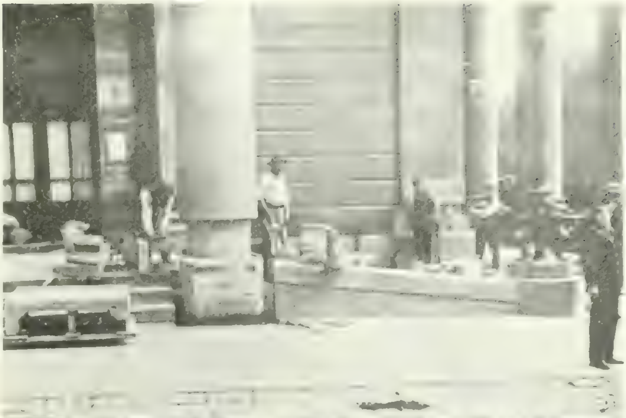


Fig. 8—Base of One of Columns Shown in Fig. 7

Attempts were made to patch the stone as at *a* without success and the work was thoroughly done later as indicated in Figs. 9 and 10.

The officials responsible for the statuary came to the conclusion that there would always be this danger as long as sandstone was used and not only would the surface crack and spall, but even whole sections drop down. The deterioration of some of the figures only 30 years old is clearly illustrated and all possible methods and experiments were made to determine the best way to protect the new statuary, but nothing could be done to counteract the effect of the weather. Among some of the rather drastic means employed was the replacement of the upper parts of some figures with new parts of sandstone, but the lower portion of the figure continued to decay and it is evident that the upper part will in due time follow the same course.

The officials proposed to effect a final remedy and decided to replace all of the statuary with artificial stone of the same profile. This decision was arrived at after inspecting several old artificial stone figures which, without any special methods of 'preservation, had shown practically no deterioration after some 15 to 20 years of exposure to the elements. It was decided to have the



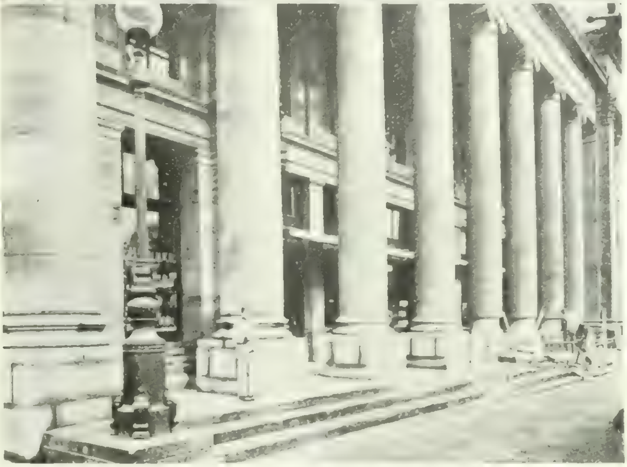


Fig. 9—Restoring Disintegrating Columns With Concrete

Fig. 10—The Work Completed; Joints Still Wet

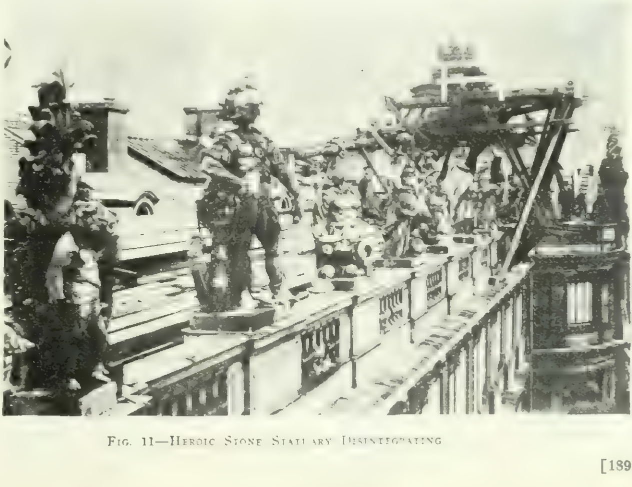


Fig. 11—Heroic Stone Statuary Disintegrating

Figs. 12, 13 (at Top), Fig. 14 and Below it Fig. 15, Fig. 16 at the Right—Telling the Story of the Restoration of the Statues With Concrete

new statuary of the same color and texture as the sandstone and the work of replacement of the statuary was conducted along the following lines:

The old sandstone figures were removed one by one from the building with the greatest care and shipped by rail to the factory. The old figures were partly so brittle and deteriorated that they could be shipped in sections only. These were assembled in the factory with great difficulty. This is well illustrated by Figs. 12 and 13, showing a knight about 10 feet high, originally cut out of a 135 cu. ft. block of sandstone. The missing and damaged parts were modeled partly in cement and partly in plaster and then put in place. The extent of some of these replacements is indicated in Fig. 12 where the repairs appear in white.

The remodeled statue was used to prepare the plaster and glue forms which were to be employed in casting the new artificial stone statues. After these forms were prepared and placed in position for casting, all parts were adequately reinforced with metal, carefully placed to insure maximum rigidity. (Fig. 14.) After the concrete had been cast and sufficient time allowed for hardening the forms were removed in pieces as is shown in Fig. 15. This view also shows the good appearance of the statuary upon removal of the forms, making necessary only a few finishing touches of the sculptor who chiseled off a thin layer. Fig. 16 shows the finished artificial stone statue in the foreground and the old stone one in the background. The difference between the two is certainly very pronounced, in favor of the artificial stone. It might be of interest to state that it took on the average of from 10 to 14 days to complete one piece of statuary.

Reinforced Concrete Siphons in India

At a recent meeting of the Institute of Civil Engrs. at Dublin, Ireland, the work on the Chenab canal project, Punjab, Northern India, was described. This canal obtains its supply from the Chenab river about 40 miles from where the river emerges from the Himalaya mountains. The canal has a bed width of 240′, a depth (at full flow) of 12′, and a discharge of 12,000 cu. ft. per sec. In the first part of its course the canal crosses several drainage lines; for these crossings 12 siphons are utilized, in 11 of which reinforced concrete was used. In this territory of India, reinforced concrete is something of an experiment; the project will be of interest because the work will be subjected to extremes of temperature. The details of the largest of these siphons are as follows:

Estimated discharge, 2,550 cu. ft. per sec.

Length of the barrel	342′
Diam. of the barrel	6′ 6″
Wall thickness, under canal bed	6½″
Wall thickness under canal banks	7½″
Head of internal hydraulic pressure	15 ft.
Depth of foundation below spring level	12 "

The Portland cement concrete used in the barrels of the siphons was made up in the following proportions:

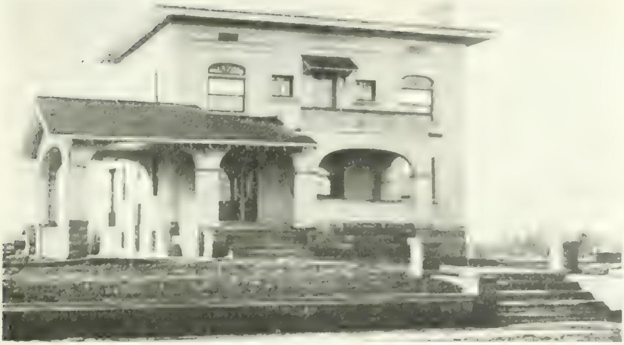
Portland cement	60 lbs.
Sand	100 lbs.
Ballast	160 lbs.
Water	22 lbs.

The Portland cement was obtained from England; the aggregate consisted of broken quartzite boulders obtained from the bed of the Chenab river and broken in a stone-breaker to ½-in. ring. For the sand content, this rock was crushed more finely. A block of this concrete, tested after one month, gave a resistance to crushing of 1,380 lbs. per sq. in.

The exact proportions of the concrete used in the foundation are as follows:—

Brick ballast	120 cu. ft.
Kankar lime	30 "
White lime	10 "
Crushed brick or Surkhi	10 "

It was hand-mixed on brick platforms, carried in baskets to the work, and rammed in 6-in. layers which formed a very hard concrete. It was, of course,



Concrete Block and Stucco House

Details of Concrete Block and Stucco House Costing $4,200

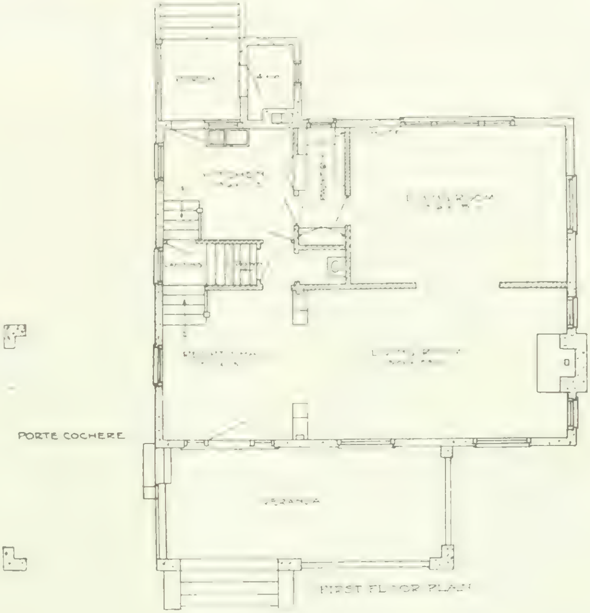
The accompanying illustration from a photograph shows a concrete block house built for F. C. Page, Springfield, Mo., and the drawings on this and the two following pages show the house in detail. As will be seen from the illustration, the walls outside have been given a stucco coat except for the foundation and the water table. The interior finish downstairs is of oak, as are also the floors. Upstairs, the floor and the finish are of hard pine. The roof is of tar and gravel. The exterior stucco finish is a white pebble-dash and the house cost complete, $4,200. The block were made by the Springfield Hide, Junk & Concrete Co., of which Mr. Page is president.

hydraulic. This siphon will cost in the neighborhood of $50,000.

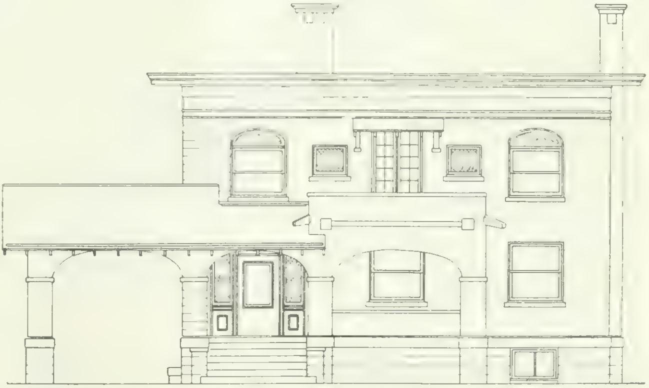
People who have not been to India are generally under the erroneous impression that work is done in a leisurely fashion. With only two European engineers to supervise the work, what would be a simple operation in this country assumed large proportions in India. The work was new to the men and the staff and coolies had to be trained up to the work. All operations had to be carried on under awnings, to protect the concrete from the heat of the sun. But, despite all this ,and with the temperature nearly always in the neighborhood of 90° F., the work was completed well within the anticipated time.

Clam Clamor

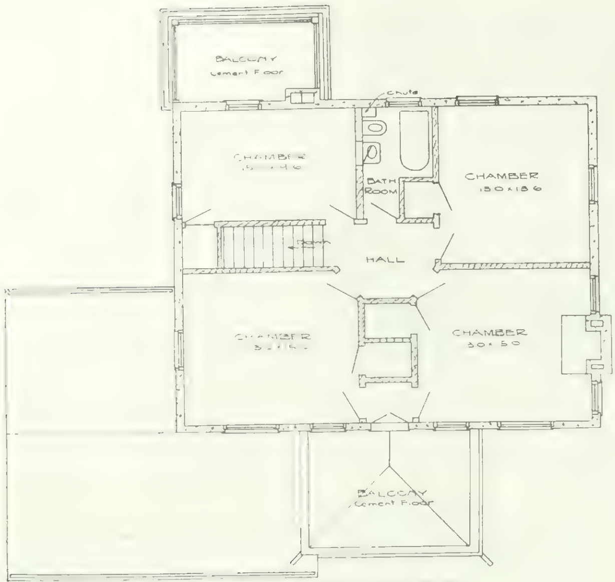
Iconoclastic college professors, in Washington, are suggesting that clamshells, stripped from the living bodies of one of our most nutritious bivalves, make good lime. In common with the Seattle *Post Intelligencer,* our gorge rises at the thought. What? Shall the succulent clam be immolated on the altar of commercial greed? Not while CONCRETE-CEMENT AGE can lift an editorial whisper. The clam, whether his native heath is Scarborough or Seattle, lives not in vain. He sucks in fatness from the ocean's salty waters, that he may tickle the palate of the gourmet and warm the cockles of the feaster's heart. Served raw, in cocktail, stewed, steamed or minced, he is one of our national delicacies. We cannot give him up at the behest of high-brow despisers of the delights of the table. Lime is important, but clams are essential. Our far western contemporary holds out a straw of hope. The matter is to be left to the final adjudication of the Washington legislature, in session at Olympia. Says the *Post-Intelligencer*: "An attack on the clam, such as is proposed, is an attack on Olympia and Olympia will be heard." We hope she will. We hope that she will thunder like the elder Olympus and that the Jovian thunderbolts of eloquence will overthrow the dastardly project to decimate the clam population of the Union.



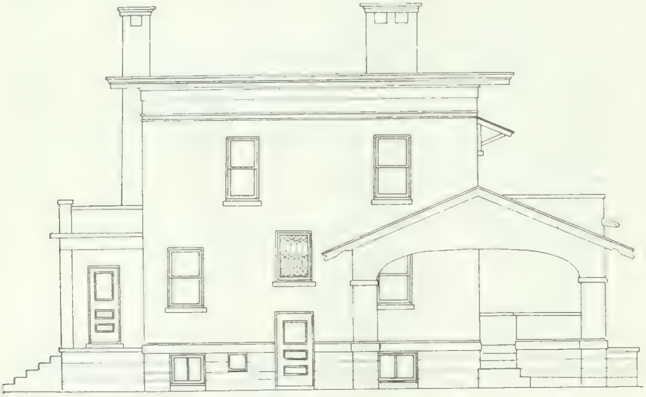
FIRST FLOOR PLAN



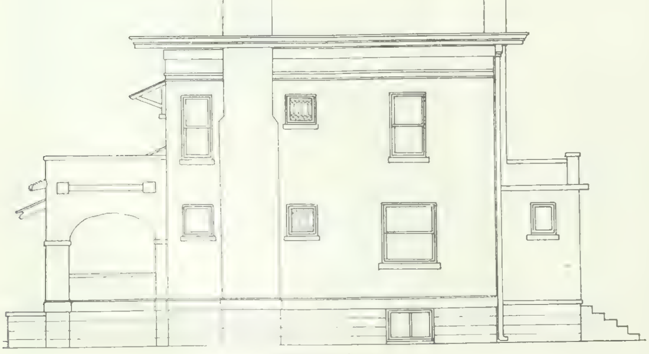
FRONT ELEVATION



SECOND FLOOR PLAN



SIDE ELEVATION



SIDE ELEVATION

Three Types of Country Roads on Concrete Base*

The wisdom of 1912, as regards road building in King county, Wn., will always stand out conspicuously in the history of road-making of this young and progressive state.

While the annual rainfall in the western part of the State of Washington is actually less than that of New York, Boston, Philadelphia or even New Orleans, the snow-capped Cascade and Olympic mountains furnish an abundance of water and moisture all the year around. The numerous rivers and rivulets, formed by the glaciers of these mountains, augmented by a light but rather constant rain, have a tendency to flood its valleys and render its dirt and gravel roads impassable.

The building of roads on the western slope of the Cascade mountains and the eastern and the northern slope of the Olympic mountains is, therefore, a very difficult task.

On account of the steady rains and the many mountain streams, the subject of proper drainage and road maintenance has received a great deal of attention and millions of dollars have been spent for this kind of work, while enormous sums are now being spent to build permanent, hard-surfaced roads, properly built and drained.

It is only in the year just passed, however, that Portland cement concrete has come into use on the state's country roads, but it is very rapidly gaining favor and all careful students of the conditions as well as the leading Good Roads men stand united in favor of hard-surfaced roads on a Portland cement concrete base, on all trunk highways leading out of the principal trade centers, which naturally carry the heaviest traffic.

This genuine enthusiasm is the natural result of a number of unsuccessful experiments with water-bound macadam and bitulithic road construction. On one road in particular several competing automobile-freight truck lines, operating between Seattle and nearby towns, damaged these types of roads to an alarming extent. In fact, the brand new roads began to show such weakness as to cause the commissioners of King county to call in the representatives of the several truck companies, and after a full discussion an order was issued limiting all loads, including the trucks, to seven tons. The companies had, heretofore, been able to load their trucks to a 12-ton and 14-ton capacity, including the vehicles.

At this hearing the county engineer expressed his belief that all principal highways should be built on a Portland cement concrete base.

Early last spring a movement was set on foot to secure the approval of the people of King county for a $3,000,000-bond issue to begin the construction of a comprehensive system of modern roads to connect the important centers of the county. The plan called for more

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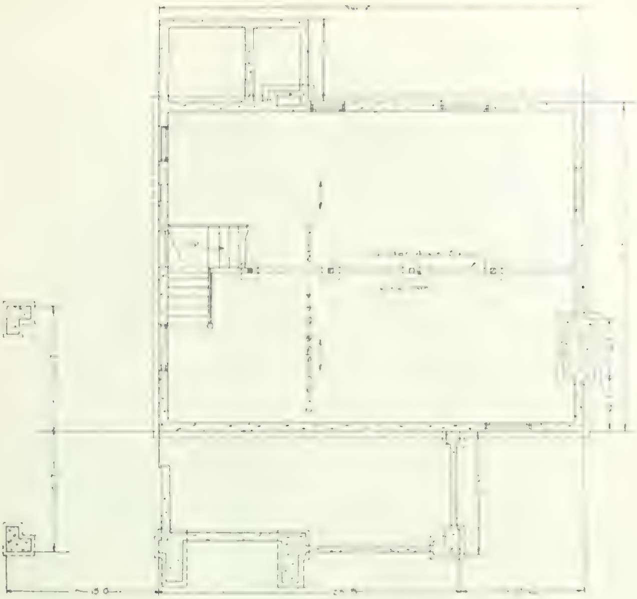
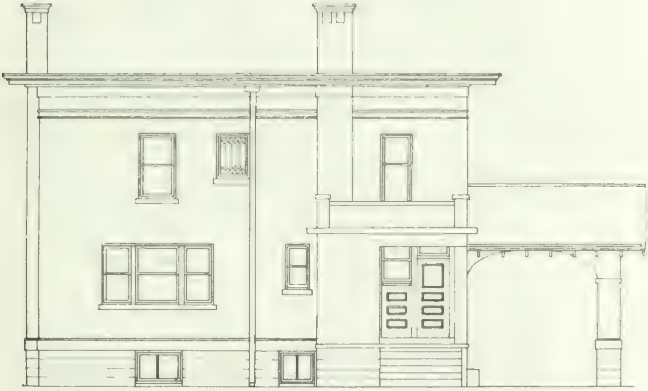
*Contributed by Western Assn. of Portland Cement Mfrs.



BASEMENT PLAN



REAR ELEVATION

than 100 miles of trunk roads of the permanent type, the general understanding being that these roads would be built on Portland cement concrete base. In fact, the sentiment against building any more "short-time roads on long-time bonds" became so intense last summer that the commissioners voted to build two sections of roads along strictly modern lines with vitrified brick surface and "Warrenite" surface respectively, but both on Portland cement concrete base.

The third type of concrete construction was ordered at the same time, by the Seattle Park Commission, in the paving of the Ravenna Boulevard with the Dolarway pavement.

The three distinct types of pavements were completed at approximately the same time last fall and all three have met with uniform public approval and universal satisfaction.

While it is a matter of speculation as to when these roads may have to be partly re-surfaced, there is a sense of certainty and security in the thought that the concrete base will never have to be relaid or repaired, provided the surface is kept in reasonably good condition.

We give herewith in essential detail the specifications for these three different roads and the total costs. It is thought by those who are in a position to know the sentiments of the tax-payers and public officials that Portland cement will be the only binder that will ever be used in permanent construction in King county on its county roads as well as on its city streets.

Specifications in Substance

[illegible]

Beginning at entrance to City of Kent, King county, Wn., and extending south on Pacific highway approximately 3 miles; 16′ 10″ wide, usual preparation of sub-grade; 5-in. concrete base, mixed in proportions, 1:3:6; 5-in. concrete curbs made and laid in conjunction with concrete foundation; 2-in. sand cushion; 4-in. hard burned vitrified brick; brick surface filled in and covered with ortland cement grout; proportions: 1 part cement to 1 part sand; total cost, $57,000; completed in Dec., 1912.

[illegible] Beginning with the limits of the town of Redmond, (King County, Wn.) and extending northeast towards Snoqualmie Falls, two miles; 16′ wide; usual preparation of sub-grade; 4-in. Portland cement concrete base, mixed in proportions 1:3:5; 2-in. course of "Warrenite" paving according to strict specifications, including the usual "flush coat;" total cost, approximately $36,000, completed in Nov., 1912.

Ravenna Boulevard—Dolarway Pavement—A section of Seattle's extended boulevard system connecting with the Pacific Highway at Ravenna Park and extending northwest about ⅞ of a mile; 32′ wide; total 13,000 sq. yds.; usual preparation of sub-grade; 6-in. Portland cement concrete base; mixed in proportion, 1:2½:4½; suitable transverse expansion joints provided at points not to exceed 25″ throughout the length of the pavement; longitudinal expansion joints left in center of roadway; expansion extends the entire depth of the pavement and filled with Dolarway bitumen and fine sand; the expansion joints do not exceed 3/16″ in width. Care shall be taken to fill these expansion joints flush with the surface of the pavement and before the wearing surface is applied. After the concrete was laid and the surface had become thoroughly dry and free from dust, or dirt, there was spread over the entire surface a layer of Dolarway bitumen, using substantially 0.4 gal. to the sq. yd. of pavement, bitumen being applied at a temperature of about 190° F. While the bitumen was still soft, there was spread over the entire surface a uniform layer of dry, clean torpedo sand or screenings of like size in sufficient quantity, completely covering the bitumen. When this was done, the street was opened to traffic; total cost, $15,340 or $1.18 per sq. yd.; completed Oct. 1, 1912.

A summary of yardage and cost on the three different pavements is shown below:

Road	Sq. Yyds.	Cost per Sq. Yd.	Total Cost
Kent—Auburn (brick on concrete)	25,836½	2.20	$57,088.00
Redmond—Snoqualmie Falls ("Warrenite" on concrete)	18,977	1.90	[illegible]
Ravenna Blvd.—Dolarway (bitumen and sand on concrete)	13,000	1.18	[illegible]

Window Tracery for Villa Nova, Pa., Church Quickly Made

From Charles Eilbacher[1] we learn of the advantage in time saved which was experienced in the construction of the Bernard Corr Memorial Church at Villa Nova, Pa. Some of the window tracery of this church is shown in accompanying illustrations—Figs. 1, 2, and 3. It was manufactured by Mr. Eilbacher. The church was designed by E. F. Durand & Son.[2]

The models were all made, or rather run in plaster and then the molds cast over the models, also in plaster. The actual casting of the stone was made in rigid plaster molds. What undercut work there was, such as the parting strip between sash lines, was also made in plaster, so that after each cast a new strip had to be inserted to carry out the design.

All of the concrete work in connection with the window tracery was done, including the detailing, making patterns, molding, casting and curing and delivery made to the job, before the natural Indiana limestone could be obtained for the window jambs. Cold weather came on before the natural stone work could be finished, but it did not interfere with the manufacture of the concrete products in a factory.

Economy of Motor Trucks in Engineering and Contracting

BY R. W. HUTCHINSON, JR., M. E.

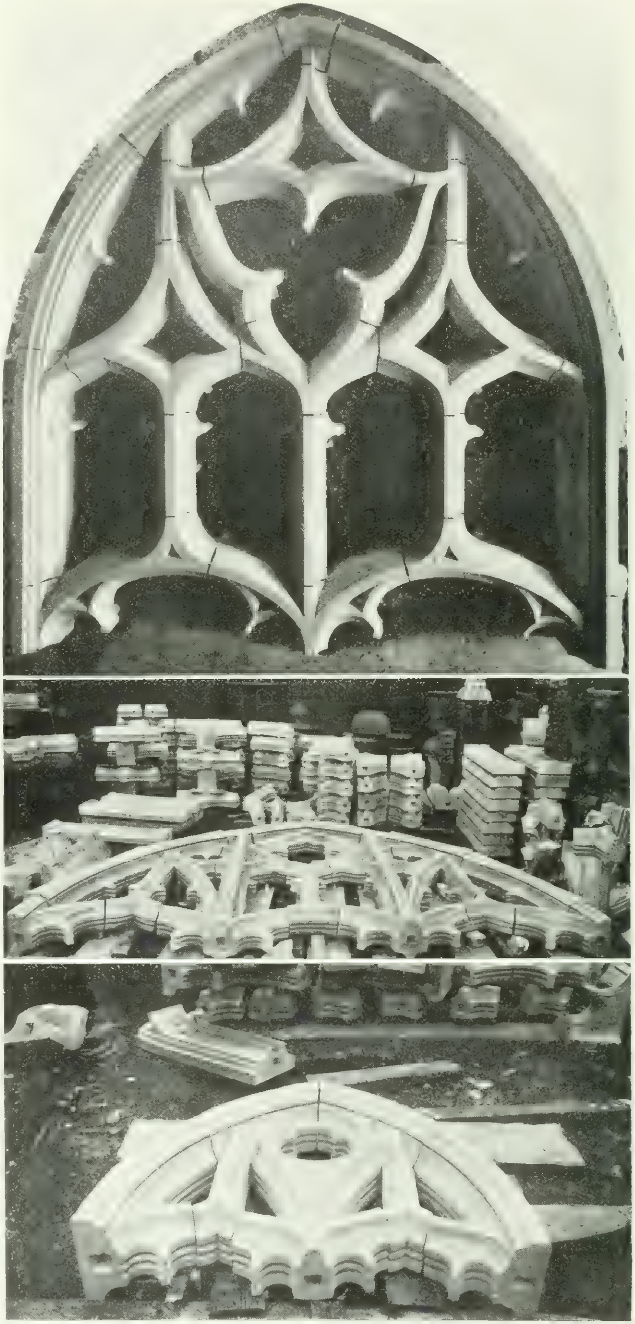
A recent report prepared by the National Association of Automobile Manufacturers on the lines of industry which were most interested in the use of motor transportation disclosed the fact that in the engineering and contracting businesses there were 482 inquirers on motor trucks as against about 300 for the next closest industry.

These figures indicate the activity in the contracting field in investigating the opportunity for the utilization of motor transportation.

Another very healthy indication of the appreciation of motor transportation by contractors is evidenced by the frequent requests which motor truck manufacturers receive for the rental of trucks for any particular contracting work.

One of the most interesting examples of the value of the motor truck in the contracting business is shown in the traffic investigation recently made by the Transportaion Cost department of the International Motor Co. The company in question, The Crescent Delivery Co., N. Y. C., is engaged in the sale and distribution of sand, gravel and broken stone. Its transportation equipment consists, in additon to horse-drawn trucks, of three Mack dump trucks of 7½ tons capacity each.

Conditions.—All the hauling is done from the company's dock, at the foot



Figs. 1, 2 and 3—(Top to bottom) Window Tracery for Villa Nova, Pa., Church of E. 35th St. (with very few exceptions). The materials are delivered for the most part in the downtown section, so that the hauls are short, the average distance being 2.95 miles. Time required for loading and unloading is reduced to a minimum. The various materials handled are carried in large overhead hoppers, which are kept filled by one stem and one electrically operated boom derrick, with clam-shell buckets. The trucks run underneath one of three hoppers, there being one each for sand, gravel, and broken stone, from which they are loaded, in a few seconds, by opening a swinging gate, or valve, in the bottom of the hopper. These gates are operated by attendants, so that the truck drivers remain on their seats, and move their trucks as soon as filled to make room for other vehicles, of which there are usually a number waiting in line. The motor trucks, as a rule, are given precedence over the horse wagons, not being required to wait in line.

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[1] 275 Morris Ave., Elizabeth, N. J.

[2] 1200 Chestnut St., Philadelphia

The unloading is accomplished with equal facility, on account of the power dumping bodies, although there are occasional slight delays when the drivers must see the contractor's foreman to ascertain where load is to be dumped, etc. These cases seem to be the exception.

The trucks, being confined to city work, are operated over uniformly good roads, excepting at the dock, where the accumulation of broken stones and the fact that more or less maneuvering is required, doubtless affect the tires to some extent, by abrasive action.

The only causes of delay are those noted above, which are almost negligible, and those due to congestion in traffic in the downtown section.

Equipment—The three trucks are of standard construction, having bodies of nominal five yds. capacity. By loading with a "crown" it is possible to load them with six yds. They were delivered with dual 42-in. x 6-in. tires, of block type, which have recently been changed to 42-in. x 5-in. triple tires, these being endless.

The trucks are geared for a maximum speed of 10.2 miles per hr. the original 13-tooth sprockets having been changed to the present 11-tooth size.

Operation—The trucks are operated nine hrs. daily, in which time 6.7 trips are averaged. The trucks make an average speed of 9 miles per hr., not including traffic or other stops, while the actual speed, as governed by traffic conditions, is 7.3 miles per hr. The maximum speed, with engine limited to 1,000 r. p. m., is 10.2 miles per hr.

The average time required to load, from the time the truck arrives at the dock, until it leaves the office where drivers receive delivery slips, is 5 min. The average time for unloading is estimated to be 8 min.

The loads vary from 15,000 lbs. in the case of broken stone, to 16,200 lbs., for a full load of sand.

The condition of the three machines, at this time, is excellent and it is evident that they are well looked after, even to the extent of frequent washing and polishing of brass.

The drivers are better than the average and take good care of their machines.

Maintenance—The garage facilities are of the best, and the location of the garage, in E. 31st St., reduces dead mileage to a minimum.

No facilities are at hand for repair work, except light repairs, as there are no machine tools nor benches.

Ample provision for daily attention, such as oiling, greasing, and minor repairs and adjustments, is made by the employment of one mechanic, all of whose time is given to that work.

Practically no spare parts nor equipment are kept on hand, and in view of the close proximity to the service station, this seems unnecessary.

The figures for mileage, trips, etc., are based on the actual performance of the trucks for two weeks—from Nov. 11 to 23, inclusive, and were obtained from authoritative sources. The figures for average speed are based on the observations under various conditions. All the above are summarized in the following table.

On two consecutive days, in the above period, the trucks averaged 60 miles per day, and, while this is considerably in excess of the general average, it was accomplished without unduly speeding, the machines not working overtime, so that it is apparent that the fact that the average daily mileage is 39.4 miles only is not due to any limitation of the machines, nor to loading and unloading, facilities.

It seems to be the policy of the company to hold this equipment more or less in reserve to the horse wagons, and while the wisdom of this policy cannot be questioned in view of the fact that the horse equipment costs practically the same whether working or idle, it must be borne in mind that the condition is unfavorable to the most efficient performance of the trucks. On the days when the machines are kept busy the efficiency, or the ratio between 10-mile performance and cost of operation, including fixed charges, must certainly be considered better than that of the horse equipment.

Conclusions—The conditions as outlined above, disclose very little which is abnormal, or which would justify any dissatisfaction on the part of the owners. The short hauls, traffic delays, etc., are inherent in the business, but these are largely overcome by the exceptional facility with which the trucks are loaded and unloaded. The drivers are under efficient supervision, and there seems nothing in connection with the handling of the trucks, while in service, that is susceptible of any improvement.

The average consumption of gasoline for the period covered by this report, and since it was known that an investigation was in progress has been considerably less than what it was before, according to Mr. Warren, secretary of the company, and while no deduction should be drawn from this fact, it suggests a better check on this item of expense.

The particular value of this report is that it proves that short-haul service is equally as profitable for a motor truck as long-haul service when the loading and unloading conditions prevent the waste of time keeping a truck idle.

Cost of Operation of 3 7-Ton Dump Trucks

Conditions:

Average daily mileage 39.5 miles.
Average trips 6.7 miles.
Average length of haul 2.95 miles.
Average load 8 tons.

Assumption:

300 working days per year.
11,350 miles per year (each truck)
100,000 miles life of truck.

Investment:		
Three 7-ton "Mack" Dump Trucks	$17,400.00	
Fixed Charges:		
Interest on $8,700 @ 6%	522.00	
Insurance:		
Fire, 2% on 80% of value	278.40	
Fixed depreciation (exclusive of tires) on $15,450 @ 10%.	1,545.00	
Wages @ $22.50 per week	3,510.00	
Garage @ $20 per month	720.00	
Total fixed charges		$ 6,575.40
Operating Charges:		
Depreciation @ 1% per 1,000 miles for all mileage in excess of 1,000 miles	$ 285.83	
Maintenance @ $.079 per mile (approximately)	2,821.00	
Tires @ $.0809 per mile	2,877.42	
Gasoline @ $.067 per mile	2,380.07	
Oil and grease @ $.013 per mile	468.00	
Total operating charges		$ 8,832.32
Total cost per annum		15,407.72
Average cost per ton mile		.108
Average cost per day		17.12

Dr. S. W. Stratton, Dir. of the Bur. of Standards, Washington, has been elected to and accepted membership in the Council of Underwriters' Laboratories. The Council of the Laboratories is composed of 22 of the leading experts of the U. S. and Canada, who serve without recompense and supervise the technical work of the institution.

The growing importance and extent of the work of Underwriters' Laboraories in connection with the general movement for reduction of the fire waste in America, together with some work in this field which the Government has outlined, make Dr. Stratton's appointment to membership in the Laboratories' Council a particularly happy one at this time.

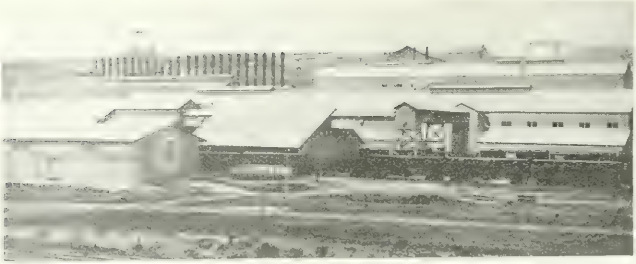

Fig. 1—Where "[illegible]" Cement is Made. The Santa Cruz Portland Cement Co.'s Plant [illegible]

Growth of Cement Industry on Pacific Coast*

BY CHAS. A. NEWHALL†

The industry on the Pacific coast is a little more than 29 years old. In the late 80's and early 90's, two plants in California were making a natural cement from the argillaceous limestones occurring at Jamul in southern California and at Santa Cruz in the central part of the state. A plant at Benecia, north-east of San Francisco, was making a cement from a calcareous conglomerate. At these plants the natural rock was quarried and broken up by hand. This rock, without further treatment, was burned in standing kilns of simple construction. The burnt rock was cooled and then picked over by hand. The pieces that showed the proper degree of burning were crushed and ground to a powder in the old-fashioned burr mill. The equipment of one of these natural cement plants probably would not cost to exceed $5,000. The whole process was exceedingly crude and the investment very small as compared with the modern cement plant.

Moreover the cement made at these early plants was untrustworthy and exceedingly irregular in quality. The cement made at Benecia was used in the construction of the city hall at San Francisco and the poor quality was well shown in the ruins after the big earthquake of 1906.

The poor quality of the product and competition with imported Portland cement caused these natural cement plants to cease operation.

The First Pacific Coast Plant, 1884

The first plant to make a true Portland cement of good quality was operated in Oregon. Several early writers mention this plant and state that it was the first to use successfully a rotary kiln. I had long tried to get particulars about this plant. None of the cement men on this coast had ever heard of it and I have never found anything in the literature more than the statement given above. The history of this plant would be particularly interesting, for the reason that Oregon is now one of the few states in the Union and the only state on the coast in which no plant is operating or is likely to operate. When I was in Portland, I took pains to find out something about the long-lost plant. After going through the State Geological Survey reports and old newspaper files, I found a reference to the Portland Cement Co., of Portland, together with names of officers. One of these men I found is still living in Portland. This gentleman told me that he had not thought of the plant for 25 years. In 1884, when he was a young fellow he had put all his money—about $5,000—into the proposition and had served as secretary for the company. The plant was located at Oregon City on the spot where the city pumping plant now stands. The factory was designed and managed by a Mr. Middleton. This man must have been a genius in his line, for his plant was built along plans that did not come into general use, even in the older cement plants in the East, until 10 years later. The raw material, a cement rock from southern Oregon, was ground in pebble mills and this raw mix was burned in a gas fired rotary kiln. The resulting clinker was ground to a cement in a pebble mill. The gas was made for the most part from Australian coal, though local coal was used to some extent. Power was derived from the falls of the Willamette, just above the plant.

The output of this pioneer plant was 100 bbls. per day of true Portland cement. The product was in great demand and was superior in quality to the imported Portland cement. The cement was used in sidewalks and curb work and in making artificial stone.

The plant was operated on this scale for a little over a year and then it was decided to raise the capitalization of $50,000 and increase the capacity of the plant. About this time the directors ordered a survey of the quarry. It was discovered that the rock was practically exhausted. They had been operating on a thin saucer-like body of stone that was standing on edge against the side of the hill. What they had supposed to be an inexhaustible mountain of stone was in reality a thin veneer.

This discovery led to discord. Some of the stockholders quit. Middleton and the heaviest stockholders attempted to rebuild the plant and operate on other quarries but with poor success. They finally gave up and along about 1890 the machinery was broken up and sold.

Later Developments

In 1894, Uriah Cummings, one of the most experienced men in the cement business and owner of a large factory

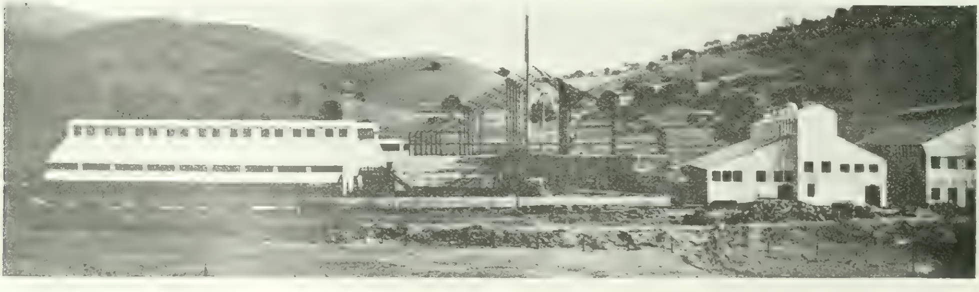

Fig. 2—Works of the Cowell Portland Cement Co.

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*A paper delivered before the Pac. N. W. Soc. of Engrs.

†Seattle, Wn. Member Am. Inst. Chem. Engrs.

in New York, planned to start a plant near Los Angeles. He knew the game thoroughly, and went into the matter of transportation and freight rates at the very first. At that time the railroad practically owned California. After delaying matters for several months the officials called Mr. Cummings into conference and presented him with a tariff sheet. These rates, he discovered, had been figured exactly to balance the profit he had counted on making. He told them that they were working a hold-up game and that he would not pay their rates. He then gave up all plans of operating a plant on the coast and went back East.

The first plant to operate successfully was started in 1898 by the California Portland Cement Co., at Colton—about 50 miles east of Los Angeles. The initial capacity was only 500 bbls. per day. This old plant was later remodeled and four years ago a new mill was built increasing the capacity to 2,500 bbls. per day, of "Colton" cement. With modern machinery and new methods of controlling the raw materials, this plant is now making a high-grade cement.

In 1903 two plants were started; the Standard Portland Cement Co., at Napa Junction, Cal., and the Pacific Portland Cement Co., at Cement, Cal. Both of these plants are near tide-water on San Francisco Bay. Both companies were very successful from the start. The cement compared favorably with any on the market at that time and was in great demand on account of the price being a little lower than that of the imported cement. Both plants were enlarged from time to time and in 1906 each company built a new mill.

The new mill of the Pacific Portland Cement Co. was located only a short distance from the old mill. Both mills draw raw material from the same quarries, so the product of each mill is essentially the same. The combined capacity of the two mills of the Pacific Portland Cement Co., is about 5,000 bbls. per day of "Golden Gate" cement.

The Standard Co. located its new plant, the Santa Cruz Portland Cement Co., at Davenport, Cal., near Santa Cruz, and about 150 miles south of San Francisco. The raw materials used at this new plant were vastly different from the materials used at the old plant at Napa Junction and consequently there was a great difference in the quality of the finished product, that made at Santa Cruz being a lower grade cement. The attempt to market the cement from both mills under the same brand was a failure and the company was later reorganized. The Napa Junction plant marketed the "Standard" brand. The factory at San Cruz was remodeled and a different kind of raw material used. The product was marketed as the "Blue Cross" brand. The Santa Cruz plant is the largest single unit in the world, with a rated output of 12,000 bbls. per day.

In 1907 the Washington Portland Cement Co. started operation at Concrete, Wn., in Skagit county, with a capacity of 800 bbls. per day. Three years later the capitalization was raised to $700,000, and the daily capacity was increased to 2,500 bbls. of "Washington" cement.

The next year, 1908, the Superior Portland Cement Co., was started, the plant not one-half mile away from the plant of the Washington. The Superior is capitalized at $1,000,000 with a daily output of 1,500 bbls. of "Superior" brand per day.

In 1909, two plants were started; that of the Riverside Portland Cement Co., at Riverside, Cal., with a capacity of 3,000 bbls. per day of "Riverside" brand; and that owned by the Los Angeles Aqueduct Commission of the City of Los Angeles.

The history of this experiment in municipal ownership is interesting and I would like to go into details but the discussion would hardly fall in with my subject. It is sufficient to say that when the Aqueduct commission called for bids on something like 1,000,000 bbls. of cement the manufacturers put in a figure that seemed unduly high. The engineers of the Commission figured that they could build and operate their own plant and still save the City a good sum, so the bids were rejected and the municipal plant constructed. Figures given by Mr. Mulholland[1] show that the City has been saved a considerable sum over the original bid of the manufacturers but would break about even at the price for which cement is now offered.

In 1910 the plant of the Golden State Portland Cement Co., was started at Ore Grande—on the Mojave Desert, in southern California. This plant is capitalized at $200,000 and rated at 1,000 bbls. per day.

In 1911 the Inland Portland Cement Co.,—a subsidiary of the Lehigh Portland Cement Co., Allentown, Pa.—began operation at Metaline Falls, Wn., north of Spokane.

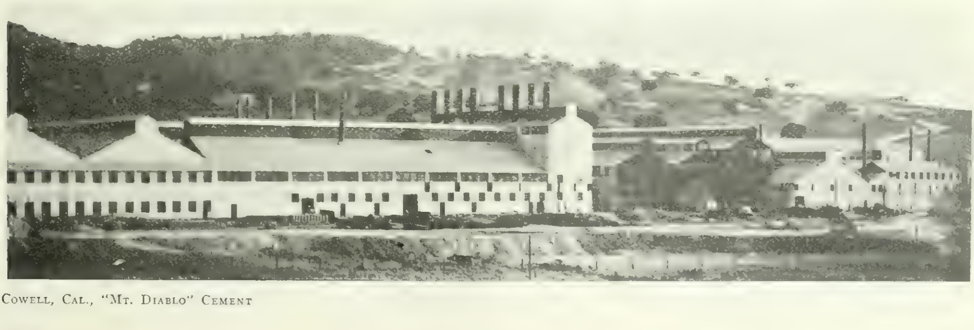
In 1913 three new plants will be in operation—the International, just out of Spokane—the Olympic in Bellingham, Wn., and the San Juan near Watsonville on Montery Bay, Cal.

Changes in 29 Years

In the 29 years since 1884 the cement industry on the Pacific coast has grown from the single plant at Oregon City with its 100 bbls. per day capacity and $50,000 capitalization to a total of 13 plants, capitalized at about $24,000,000 and with a combined output of about 38,500 bbls. per day.

During this 29 years of physical growth there has been an even more astonishing change in the quality of the cement. While it is common knowledge that the industry has grown very rapidly but few people realize or know of the revolutionary changes that have taken place in the methods of manufacture with the resulting changes in the quality of the cement produced by these new methods. On the Pacific coast these changes have been felt within the last five years only, though in Europe and the East the transition from old methods to new has been more gradual and has extended over a period of about 15 years.

Even 10 years ago very little was generally known about the chemical and physical changes that take place in the manufacture of cement. The whole process was shrouded in mystery. Each mill superintendent had his own formula for "making the mix" and for treating the raw materials. There were many "patent methods" and "secret methods" of making cement. I know one man who made a tidy sum by selling his secret formula for making cement to a group of capitalists. Another took in a royalty on every bbl. of cement sold for years because of a patent he held on a fluxing agent. Once, in all innocence, I explained to the superintendent of our plant how we calculated the mix; when my chief—an old timer of the mysterious sort,—found out what I had done, I nearly lost my job; in fact, this bit of communicativeness on my part eventually led to my undoing at that plant.



Cowell, Cal., "Mt. Diablo" Cement

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[1] Ch. Engr. Los Angeles Aqueduct Commission.

Let me say right here that there is nothing mysterious in making cement. It is just a matter of plain chemical engineering and the use of ordinary common sense in keeping a bunch of men working happily together. The process of making cement consists in grinding a mixture of limestone and clay together to a fine powder and heating this mixture to incipient fusion; this partly fused entire mold should cost in time spent. A mold must be as nearly perfect as the cement. That in a very few words describes the whole process of cement making.

The Chemical Engineer in the Cement Plant

The great change in the quality of cement took place when the plant manager no longer heeded the methods of the mysterious people but changed to the wide-open methods of the chemical engineer. It has taken some plant managers a long time to order the change and sometimes the change was made in a half-hearted way, because of the expense involved. Always there was fighting and grief between the men of mystery and the chemical engineer because no man will see himself displaced without putting up a fight. Every plant on the coast is now run according to the principles and methods of chemical engineering. In some the principles are heeded more than in others and the quality of the product varies in proportion to the number of times these principles are disregarded.

Now the principles of chemical engineering as applied to the cement business may be stated as: first, a complete knowledge of the chemical composition of the raw materials; and second, full control of every step in the manufacturing process.

The first five plants here on the coast were constructed without any regard for these points. Economy in handling the materials was the main feature in their design.

In these plants no provision was made for sampling and testing the raw materials prior to mixing. In one plant where I worked, the mix was made 48 hrs. before we had a chance to check the composition. If the composition was found to be wrong, we had no way of correcting it. I have often seen the composition of the mix jump in two hours from 70% to 77% carbonate of lime. Nowadays we get excited if the composition varies by ½ of 1% in a 24-hr. mix. Of course all this guess-work meant an irregular and low-grade product.

Competition and more stringent demands on the part of consumers soon forced the remodeling of the old plants. Storage bins for ground limestone and ground clay were installed so that the chemist could determine the exact composition of the raw materials and thus be in a position to make a uniform mix. In the latest plant the further refinement of a correction tank has been installed. The chemist has a second chance to analyze the mix and bring it to the exact composition desired, thus insuring a cement of absolutely uniform quality.

Nowadays in an up-to-date plant every step in the manufacturing process is under close watch. The fineness of the raw mix and of the finished cement is tested every hour of the 24. Each kiln is watched closely and kept under accurate control by means of variable speed motors. In one plant, recording pyrometers[2] and draft gauges are in use on each kiln. The chemist has found that a uniform fineness and a uniform kiln treatment are just as essential to the production of a high-grade cement as is an exact chemical composition.

TABLE I.

Fineness: Through 100-mesh sieve			89.75%
" 200 " "			69.63%
Set: Initial			5° 10'[3]
Final			7° 40'
Tensile Strength: Neat	1	da.	203 lbs.
	7	"	695 "
	28	"	788 "
1 cement: 3 sand	7	"	131 "
	28	"	194 "

[3] (°) is used here for "hours;" (') for minutes.

TABLE II.

Test Sheet Showing Variation in Quality of Portland Cement

Sample	Fineness		Set		Soundness	Tensile strength in lbs. per sq. inch				
						Neat Cement			Sand 3 to Cement 1	
No.	% through 100-mesh	% through 200-mesh	Initial	Final		1 da.	7 da.	28 da.	7 da.	28 da.
1	90.0	69.6	2° 45'	6° 45'	poor	250	535	710	135	290
2	98.4	84.0	3° 45'	6° 15'	perfect	213	532	660	225	375
3	92.0	81.6	4°	6°	"	210	550	700	180	350
4	97.6	91.2	3° 20'	6° 30'	"	430	750	900	450	475
5					"	275	645	750	250	420
6					"	167	602	775	230	398
7					"	70	285	600	100	258
8	98.0	95.2	2°	6°	"	340	820	890	445	590
8a	(Mixed 4 sand:1 cement instead of 3:1)								300	380

Detail of Samples used:

No. 1 Cement used in Vancouver, B. C. Brand "A," very low grade.
No. 2 Cement used in Vancouver, B. C. Brand "B," average quality.
No. 3 Cement used in Seattle, Wn. Brand "C," low grade.
No. 4 Cement used in Seattle, Wn. Brand C," high grade; bought one month later than No. 3; furnished after No. 3 had been rejected.
No. 5 Cement. Brand "D," fresh from grinding mills.
No. 6 Cement. Brand "D," stored in sealed jars for 90 days.
No. 7 Cement. Brand "D," stored in open shed for 90 days.
No. 8 Cement. Brand "E," used in Seattle, Wn. Very high grade.

To indicate the great change in quality that has been brought about by these new methods it is of interest to compare the tests of Sample No. 8 shown in Table II with the following tests (Table I) made five years ago. These cements were made at the same plant and from the same materials. The new process cement is 240% better than the old.

A like increase in the quality of the product can be shown in every plant in which the principles of chemical engineering have been adopted and consistently followed.

It may be asked here, why, if we know how to make high-grade uniform cement, do so many companies send out poor stuff at times. The answer is that a cement plant is run first of all to make money and to make money the quantity of the output must be kept up. There is a dividing line between quantity and quality and some manufacturers will let the quality suffer just as long as there are enough careless engineers around to use up poor quality stuff.

It has always been a mystery to me why an engineer or architect will allow low-grade cement to go into work when he can buy high-grade cement for the same price. If engineers could buy cement under specifications worded so as to recognize the fact that different grades of cement exist—calling for high-test cement for important work and low-test and cheaper cement for the less important work, I believe the whole question of quality would take care of itself.

As to the future of the industry:—Even with the great increase in production due this year there is every reason to believe that one or two more plants will be started in the near future. So far the increased production has been more than offset by the increased consumption. The Good Roads movement and the harbor improvements that are bound to come with the opening of the Canal will create a new market for a vast tonnage of cement. The day of permanent construction is here and good concrete is the one permanent structural material.

American Engineers in Tour of Germany

To foster a broader commercial spirit between America and Germany, about two hundred of the most prominent mechanical engineers of the United States will go to Europe this summer to attend the 54th Annual Meeting of the Verein Deutscher Ingenieure in Leipzig and to inspect the educational and industrial establishments of Germany. The party will sail on June 10 on the Hamburg-American line S. S. Victoria Louise, the largest and most superbly appointed cruising steamer afloat. Many friends of the engineers are also planning to sail on the steamer and will probably compose the entire passenger list. The official party will consist of two hundred members of The American Society of Mechanical Engineers, accompanied by one hundred ladies.

The party will leave on June 25 for a tour of industrial Germany, visiting Dresden, Berlin, Cologne, Düsseldorf, Frankfurt, Heidelberg and Munich, including a trip up the Rhine.

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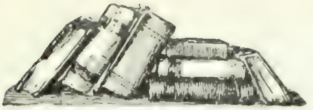
[2] A description of such an installation is published on page 20 of the Cement Mill Section for Feb., 1913.



NEW BOOKS

Cost-keeping and Management Engineering. Halbert P. Gillette and Richard T. Dana. Myron C. Clark Pub. Co., N. Y. C. 9¼" x 6½", cloth bound, 346 pp., illustrated. $3.50.

Conservation is the demand of the age and efficiency engineering is no more than conservation applied to industrial effort. Coming down into the field of concrete construction, efficiency engineering means primarily not cost-keeping systems, but cost-*reducing* systems, for in the last analysis the final measure of any effort is the cost of production. This volume is essentially a text-book on construction cost-reducing systems, and as such will be found of interest to every engineer and builder working along this line.

* * *

Mine Fires—By George S. Rice, Department of the Interior Bureau of Mines (Technical Paper 24). Washington, D. C. 51 pp. 9"x6", paper bound.

In mine operation the constant endeavor is to lessen the risk of life and property by mine fires. This booklet reviews construction equipment and methods making for this end.

* * *

Fire Prevention and Fire Protection. Joseph Kendall Freitag. John Wiley & Sons, 45 E. 19th St., N. Y. C. 7¼"x4¼", leather bound, 1,038 pp., illus. $4.00.

This volume is a convenient summing up in a manner suitable for ready reference the present status of fire-resisting buildings. The handbook presents not only these details of construction making for fire-resisting building but also descriptions of preventive means and broad principles of scientific fire protection design without which the construction details are of little avail. The opening chapters take up the questions of fire protection and fire prevention. This is followed by a summary of fires in fire-resisting buildings. The question of fire-resisting design is then discussed in detail. Altogether the hand-book, published uniformly with engineers' hand-books, will meet a real need in the field.

* * *

Manual of Cement Testing. By Wm. Allyn Richards, Instructor, Univ. of Chicago; and Henry Briggs North, Assoc. Prof. Chemistry, Rutgers College. D. Van Nostrand Co., 25 Park Place, N. Y. C. 8"x5¾", 40 pp., illus., cloth bound, price $1.50.

This is a manual based on the standard specifications of the various societies and covers in detail the procedure followed. Forms are suggested by which data can be recorded. The volume is a detailed instructive text covering the matter thoroughly.

* * *

Elevator Shaft Construction. By H. Robert Cullmer. Wm. T. Comstock Co., 23 Warren St., N. Y. C. 9¾"x7", cloth bound, 174 pp., illus. $3.00.

Today is the day of the specialist, and the volume at hand is essentially a specialized book, dealing exclusively with the problem of elevator shaft construction. The matter presented has been gathered by the author from his own practice and systematized and generalized for the purpose of the volume.

By using both sides of the leaf for the plates the matter presented might have been considerably condensed and put in more convenient shape, but as it stands it should be of interest and real value to architects and building designers in general.

* * *

Oil and Gas Wells Through Workable Coal Beds. Bur. of Mines, Washington, D. C. 9"x5¾", paper bound, 101 pp., illustrated.

Where gas or oil wells abound in the vicinity of coal mines it is very essential that steps be taken to protect the well where it is adjacent to or passes through the gallery of a mine. This bulletin describes in detail the methods of using concrete between the casing and the tubing to effect this end.

* * *

Manual for Engineers—Pub. by Univ. of Tenn., Knoxville, Tenn. 248 pp., 5¾"x2¾", leather bound, 50 cts.

A vest-pocket manual is somewhat unusual and a new edition of the above book is always welcome. In the preface the author, Prof. Charles E. Ferris, of the Univ. of Tenn., states that the object of this book of engineering data is to secure a medium whereby the strongest possible argument in favor of technical education as a means of developing the undeveloped resources of the South can be brought before the men who control the affairs of the South. While the matter covered is a little more along mechanical and engineering lines than construction work, yet there are many valuable data presented in a concise way.

* * *

The Slide Rule Simplified. Geo. W. Richardson, 4212 24th Place, Chicago. 40 pp., size 10"x6¾", paper bound, illustrated. Published by the author.

This pamphlet discusses in detail and shows by many illustrations the essential operations of the slide rule. While the actual operations discussed refer largely to electrical, mechanical and general problems, yet the underlying principles are the same for all operations, and the book should be of considerable value in making this useful tool plainer.

* * *

Safeguards. Aetna Life Insurance Co., Hartford, Conn. 9¾"x6¾", paper bound, 174 pp., illus.

In modern industry the toll of human life and limb has reached such startling figures as to be a serious menace. Investigations have shown that a large proportion of our industrial accidents can be avoided by proper preventive measures. This book shows in detail, with well-worded and clear talk, and many illustration the way in which a great number of machines in every day use can be safe-guarded.

* * *

Woodworking Safeguards. Aetna Life Insurance Co., Hartford, Conn. 9¾"x6¾", paper bound, 217 pp., illus.

This book, very similar in preparation and purpose to the one noted above, specializes in safeguards in wood-working machinery. The author of this book is David Van Schaack, director of the Bureau of Inspection and Accident Prevention, of the Aetna Life Insurance Co.

* * *

Distinctive Homes and Gardens of Low and Moderate Cost. By Geo. M. Kauffman, 619 Rose Bldg., Cleveland, 13½"x10", paper bound, 87 pp., illustrated.

A well prepared and comprehensive book presenting a selection of the growth of many years' architectural thinking and planning and presents popular styles of present day domestic architecture. The book is an outcome of the best of current architectural practice. The author hopes that this volume will stimulate the demand for good homes. A prospective home designer or builder will find many suggestions of interest.

Concrete Organizations, Officials and Conventions

National Association of Cement Users, Edward E. Krauss, Secretary, Harrison Building, Philadelphia, Pa.

Association of American Portland Cement Manufacturers, Percy H. Wilson, Secretary, Land Title Building, Philadelphia, Pa.

American Highway Association, J. E. Pennybacker, Jr., Secretary, Colorado Building, Washington, D. C.

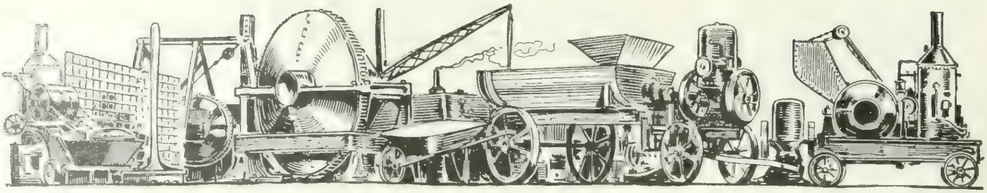
Northwestern Cement Products Association, J. C. VanDoorn, Secretary, Security Bank Bldg., Minneapolis, Minn.

Cement Products Exhibition Co., 72 West Adams St., Chicago, Ill.; Secy.-Treas., J. U. C. McDaniel, 108 La Salle St., Chicago, Ill.

Nebraska Cement Users' Association, Secy. Treas., Frank Whipperman, Omaha, Neb.

Iowa Association of Cement Users, Henry H. Dean, Glenwood, Ia., Secretary.

Canadian Cement and Concrete Association, William Smith, Secretary, 57 East Adelaide St., Toronto, Ont.



New Equipment, Methods and Materials

In this department the EDITORS endeavor to keep our subscribers informed upon new tools, methods, machines and materials used in this industry. It is in no sense a department for the benefit of advertisers. To secure attention the thing described must be new to our readers. No matter will be printed simply because an advertiser desires it. Likewise, no matter will be excluded simply because the article described is not advertised in this paper. We aim to keep our readers informed—suggestions for the improvement of this department are solicited.

The Development of Metal Lath

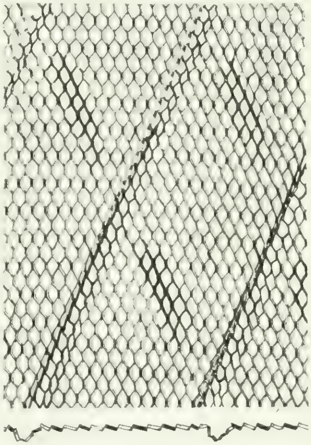
The first record of a patent granted for a metal lath is dated 1839. This metal lath was a rather crude material consisting of a punched or perforated sheet of steel resembling more than any thing else a grater. No improvements were produced until after the Civil War. All of the various laths designed at that time were merely variations of the punched or perforated sheet idea or some system which merely substituted a strip of steel for the customary wooden lath. Metal lath did not become a practical material until the invention of expanded metal in 1885.

The record of any material is that of an evolution, and this is true of expanded metal. The first expanded metal lath was very crude when compared with the material produced at the present time. The original machines were slow in operation and produced a lath that did not secure the full value of the strength of the steel. It would be absolutely impossible to produce enough metal lath to supply the present demands, had it not been for the perfection of new and more rapid processes of manufacture, such as are now employed in the factories of the largest exclusive metal lath manufacturers.

A logical step in the development of metal lath was to combine the furring strips with the lath so as to form an integral material. The first attempts along this line resulted in a product having expanded metal meshes between solid V- or U-shaped ribs of steel. It was found that a disadvantage in this was the fact that these ribs would cover only on one side excepting where it was possible to back-plaster. The problem was then to produce a self-furring lath which would possess the advantages of the ribbed material and yet have the ribs so constructed that the reverse side would be completely embedded in the plaster.

After considerable experimenting and practical trials in actual building work a lath has been developed, which the manufacturers, the North Western Expanded Metal Co., Chicago, state, will meet the requirements of the problem. This lath is now being placed on the market under the name of "Kno-Fur" expanded metal lath.

The ribs of this lath have the same meshes as the fabric betwen them, and are ½" deep. These ribs run obliquely across the sheet at intervals of 12" and are arranged so that they coincide with the strands of the fabric. This results in each U-shaped rib forming a truss, making when embedded in the plaster a strong rib. The sheets of "Kno-Fur" lath are 22"x96", and the ribs are so formed that they mesh and automatically limit the amount of lap possible to use when applying the lath.

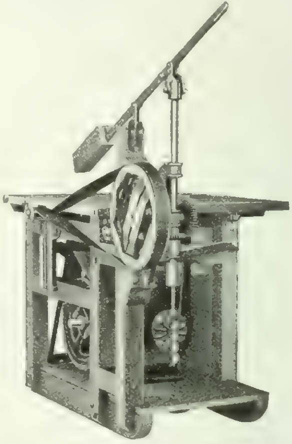


PLAN AND SKETCH SHOWING "KNO-FUR" METAL LATH IN PLAN AND SECTION

In constructing solid partitions it has been found that this material could be successfully used with channels spaced 32" o. c. The plasterer was able to apply the mortar as easily as though the supports had been spaced the customary 12" or 16". In back-plastering the decreased number of channels was found to be a great advantage. On ceiling work with the supports spaced 12" o. c. there was no difficulty from sagging when applying the plaster.

A Portable Saw Equipped With Auger

Another difficulty in building is now overcome—the boring of timbers for heavy construction work. The Oshkosh "Eveready" portable sawing, manufactured by the Oshkosh Mfg. Co., Oshkosh, Wis., has just been fitted with a successful boring device that permits boring heavy beams and girders as they lie on the ground.



PORTABLE SAW RIG EQUIPPED WITH HEAVY TIMBER BORER

It is now simply a matter of dragging the piece to be bored to the desired position under the auger. As the device can be quickly attached and detached, it does not interfere with the use of the saw rig in its many other capacities. The makers say it has been thoroughly tested out and is giving satisfaction.

* * *

Bond in Waterproofing Materials

A recent test of the adhesive bonding strength of waterproofing compounds was made by an architect of Houston, Tex., and reported as follows: Cement briquettes were broken apart and the broken ends given a coat of No. 60 "Elaterite"[1] waterproofing. Then pieces of the briquettes were put together and firmly held by rubber bands. After two weeks the briquettes were put into a testing machine and a pull of 160 lbs. per sq. in. was required to break the bond and separate the briquettes. This adhesive quality not only gives permanency as a bonding, but it gives a life, a staying quality, as a waterproofing and a resistance to water pressure not found in other waterproofing materials, says the manufacturer.

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[1] Elaterite Paint and Mfg. Co., Des Moines, Ia.

Concrete in Silo Construction

Until a little while ago, the American farmer lived prodigally. A seemingly unbounded area of farm land and an apparently unlimited fertility of soil combined to make him think little about conservative methods or intensive husbandry. He moved west at a breakneck speed—wearing out excellent land and hunting for new soil. The center of population has, however, had considerable tire trouble in its westward tour during the last 30 years and hasn't gotten very far on its journey. This means that the unlimited area and fertility story was a myth. It also means that the American farmer *must* do just what he *is* doing—he must conserve his resources, he must live and work scientifically on his original "80" or "160", and must not hope to move to richer and cheaper land when he has exhausted his own.

One effect of this change has been the erection of permanent farm buildings. This movement has happily occurred just at the height of the demonstration of concrete as a building material. The progressive farmer would no more think if trying to get along without concrete than a progressive streetcar company would think of dispensing with electricity and purchasing a herd of mules. The progressive farmer is using concrete because he knows that he can't afford to use anything else. Concrete is the cheapest building material on earth. If a concrete water trough costs originally even three times as much as a wooden trough costs—originally, and lasts 30 times as long, the wooden trough costs 10 times as much as does the concrete trough. Ask your 12-year old.

Another effect of this change has been in the conservation of farm products. The progressive stockman and dairy farmer used to waste 40% of the nutritive value of his corn crop by shucking it and leaving the stalks in the field. Today he makes ensilage out of his *whole* crop and thus realizes 166⅔% of what he did before. The progressive stockman tried the building of temporary, tumbling silos for a while—but not for long. He soon came to a realization of the value of concrete in his silo structure, and now he uses nothing else.

To meet the demand for concrete silos, many methods of erection have been developed. Reinforced concrete has been used in many forms, concrete plastered on a solid or an expanded metal sheathing of some sort, concrete block, or concrete poured monolithically. This last use has demanded the development of centering which would meet the peculiar requirements of the work, and the accompanying illustrations show a system of self-supporting steel forms for silo construction which has been developed by Polk, Genung, Polk Co., Inc., Fort Branch, Ind.

Fig. 1 is a black line sketch of this silo machine as it is called. As will be seen, the entire load is carried on the 4-in. steel pipe mast. This mast is erected at the center of the foundation when the excavation is completed, and is carefully plumbed. Over this steel mast works a movable hub, or sleeve. This hub is a steel pipe also of larger diameter, and carries the radial T-irons and larger rods which carry the forms proper. The entire equipment is made of sheet and structural steel, and is solidly designed and heavily built.

The system of assembling and taking down machines is developed to the point of comparative simplicity, a few wrenches only being required to accomplish the operation. The forms proper are made of cold rolled sheet steel and are accurate arcs of circles. Special scrapers for keeping the surfaces of these sections clean are furnished with each machine. Different diametered forms can be used on the same spider, giving a latitude for varying conditions. With the exception of a few bolts and the hoisting the whole mechanism should go through several seasons without a penny for repairs.

Both the inside and the outside form and the scaffold, and the hanging scaffold, are suspended from the angle-iron horizontals radiating from the central sleeve, and suspended by guys. After being loosened from the wall,

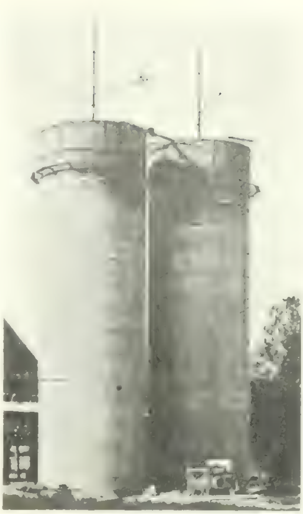


Fig. 2—This Silo, [illegible], Nearly Completed

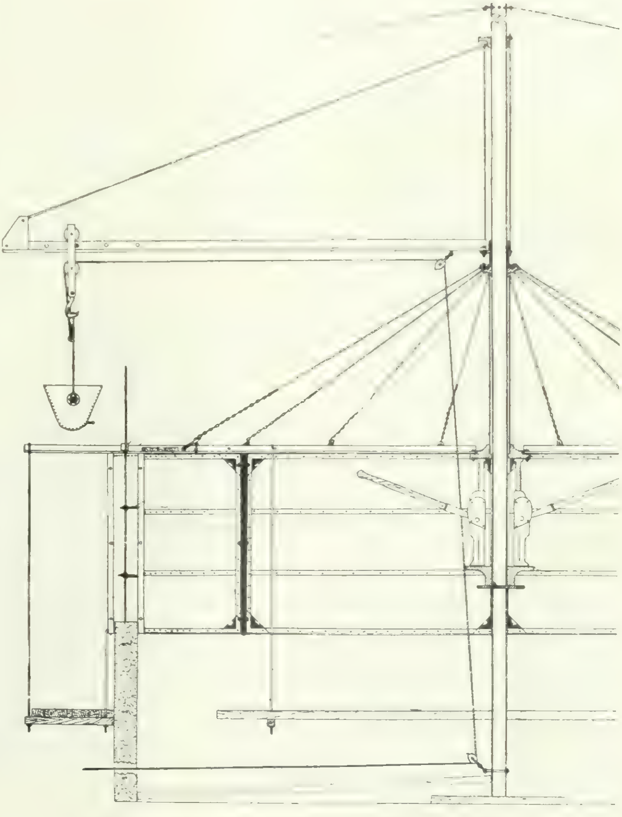


Fig. 1—Sectional Sketch Showing Operation of Silo Forms

the form is raised by jacks operated adjacent to the mast. These are supported on a movable seat bolted to the mast, and raise the sleeve, the spider and the forms at one operation.

A boom suspended from the mast is used to handle a concrete bucket. The cable for the bucket, as shown in Fig. 1, is carried along the boom, back to the mast, down the mast to its base, and out through an opening in the silo wall to the hoisting engine.

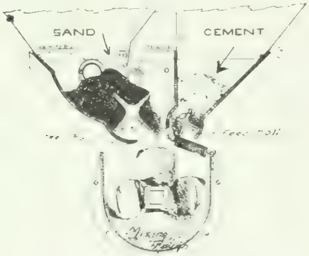
For doors, oval openings, 20" x 30" with the long axis vertical are left in the walls as the work progresses. The doors used are of heavy sheet steel, and can be fastened tightly and sealed.

The manufacturers state that erection with this system is rapid and economical. Three men can build a 16'x40' silo in 14 days, including the necessary excavation, and all the handling of the equipment required. The silo is left complete, and the equipment taken down, cleaned and packed for the next job.

* * *

Proportioning Mechanisms in Continuous Mixers

To combine cement and sand in the proper proportions for the continuous process of mixing many different mechanical principles are used. The accompanying sketch shows a cross-section of the Eureka mixer[1] through the sand and the cement hoppers and the mixing trough. The hoppers are side by side, and feed directly into the trough. The revolving steel feeder has four blades and relief rolls above the feeders maintain a uniform fill in the pockets. A worm agitator in the sand or gravel bin prevents any arching of the materials.



Sectional Sketch Showing Proportioning Mechanism of the Eureka Mixer

The proportion of the component materials is, of course, determined by the size of the pockets and the speed of revolution of the feed rolls. The two rolls, driven by sprockets from the same chain, revolve at uniform speed. Change in proportion is accomplished, therefore, by changing the size of the pockets of the feed roll. This is done by attaching to the bottoms of any of the pockets a fillet or false bottom which, of course, decreases the capacity of that particular pocket. The capacities and proportions have been accurately calibrated and adjusted; standards and tables have been developed by which any desired mix can be obtained by inserting specified fillets.

* * *

A Wall System Using Concrete Window Frames

The building forms shown in the accompanying illustration consist of 2-in. x 4-in. wood frames, covered with 24-ga. sheet steel. They are 2' 6" wide and 7' 6" long. The corner forms are hinged, and so made that they can be jointed to other forms and adjusted to form the length of wall desired.

Forms are held together by locks attached to and made a part of the forms. They are placed at the corners of the panels, and when in use, engage slots in rods running crosswise of the wall. These locks are held to the rods by iron rings, which can instantly be placed or removed.

The series of slots in the cross rods is so arranged that the forms can be set to build any width of wall, from 3" to 16". This feature allows narrowing or widening the wall at any stage of the building, as much as is found necessary, or called for by the builders' plans.

Walls are made hollow by means of collapsible cores set in the forms and removed after the concrete has set. They can be set into the forms in such a way as to form a continuous hollow air chamber in the exterior walls of the building.

Forms are provided for all-concrete frames for windows and doors. These are cast with reinforcing protruding, and are set into the walls at the proper time and incorporated with them. All walls may be fully reinforced, the reinforcing being made to extend from walls to partitions and floors without in any way mutilating the forms.

The concrete frames for doors and windows are a noteworthy feature of this development.

These forms have been developed and are being placed on the market by the Merriett Concrete Forms Co., Los Angeles, Cal.

* * *

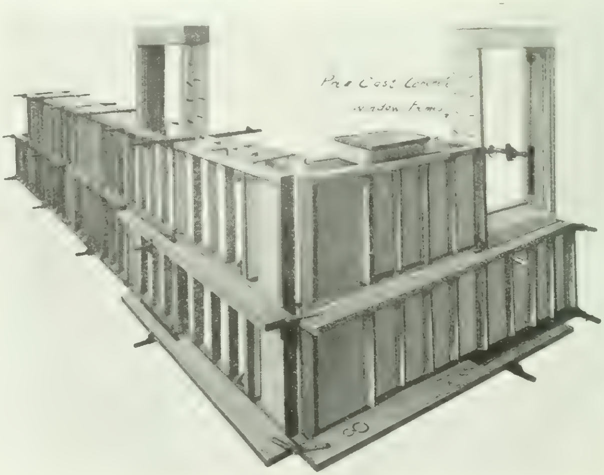
Toch Bros., paint inventors and manufacturers, N. Y. C., are sending out an interesting folder showing the launching of the super-dreadnaught New York in the Brooklyn Navy Yard. "Tockolith," a paint manufactured by this firm, was used on the hull of this battleship.

* * *

S. H. Pomeroy Co. Inc., successors to Voigtmann & Co., N. Y. C., manufacturer of metallic window frames and sashes, have moved from the old quarters at 427 West 13th to 282-296 East 134th, where the firm will have much larger and improved facilities for the manufacture of its specialties. The company has also opened a sales offices in the Townsend Bldg., 1123 Broadway, N. Y. C.

* * *

W. W. Huff and E. B. Murray announce that they have formed a firm of consulting engineers, Kansas City, Mo. This firm will specialize in reinforced concrete design and construction. Mr. Huff has had extensive experience with the Illinois Bridge & Iron Co., and the Lake Shore & Michigan Southern Ry. Co.; of this road he was assistant bridge engineer in charge of design. Mr. Murray has been connected with the erecting work in many fields and resigns as general engineer of the Kaw Valley Drainage District to enter this new company.



The Merriett System of Wall Forms
The window frames are pre-cast concrete

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[1] Eureka Machine Co., Lansing, Mich.

A Compact Power Tile Machine

The increasing use of cement drain tile naturally calls for more up-to-date machinery with which to make it, and such machinery must be so constructed as to deliver a first class tile rapidly and with the least possible labor. In other words a machine to make drain tile successfully must be automatic in action—require little floor space and be sufficiently heavy to do away with all jarring. The "Century" tile machine built by the Century Cement Machine Co., Rochester, N. Y., is designed to meet these requirements. In action it is strictly automatic and all parts are securely housed in the base, practically free from all dirt and dust. A glance at the accompanying illustration (Fig. 1) shows the simple positive action of the mechanism. The base is made in one piece without pins, bolts, etc., and weighs approximately 500 lbs., doing away with all vibration.

The machine is driven by means of pulley *A* mounted on shaft *B* and attached to mitre gears *C* which drive the main shaft *D*. On shaft *D* is mounted a spur gear *E* which meshes with spur gear on packer shaft *F* to which is attached the packer head. In this way the packer head is rotated continuously while machine is in operation. The raising of the packer head is accomplished by a unique method that is at all times dependable and sure. The worm *G* is mounted on shaft *D* and meshing with worm gear *H* mounted on shaft *J* drives the latter.

On shaft *J* is mounted spur gear *K* which meshes with spur gear on crank shaft *L* on which is mounted crank *M*. Crank *M* is connected to packer shaft by connecting rod *N* in such a manner that packer shaft is free to rotate. The crank in rising and so packing tile makes one complete revolution which carries it the full length of the tile and back to its original position.

In Fig. 1 the crank is shown at its highest point, which means that packer head is at the top of tile. When starting to make a tile the crank is at the bottom and by simply pressing foot lever *O* a pin is released which allows crank to make one complete revolution. When pin is released the crank shaft *N* starts to revolve and it will be noted that as crank revolves, starting from *A* position at the bottom the rise of packer head is slow at the start while it rises faster through the middle portion of the tile, slowing down again at the upper end. This is a very important action on the part of the machine as it packs the ends of the tile especially hard and giving the inside a perfect smooth finish.

After the tile is formed and the packer head has returned to its original position, a half turn of crank *P* raises hopper *R* away from the casing and allows the removal of casing containing the completed tile.

* * *

A Correction.

On page 96 of the Feb. issue, in describing a fireproof roof construction in which a concrete slab on "Self-Sentering"[1] is used over a structural concrete steel slab, the cost was stated as $17.95 per sq. ft. This should have been, of course, for 100 sq. ft. as should have been each item making up the total. This should have appeared as follows:

[illegible]	$ [illegible] per 100 sq. ft.
[illegible]	1.7[illegible] per 100 sq. ft.
2-in. slab concrete (in place)	7.00 per 100 sq. ft.
Waterproofing	3.75 per 100 sq. ft.
Total	$17.9[illegible] per 100 sq. ft.

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[1] General Fireproofing Co., Youngstown, O.

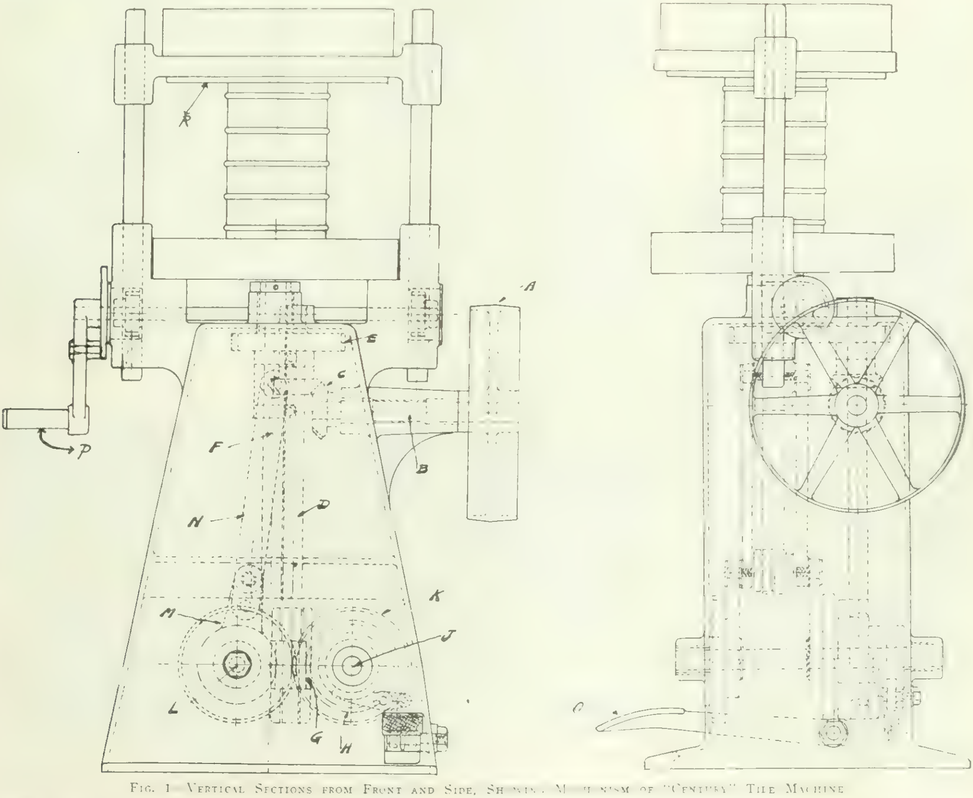


Fig. 1—Vertical Sections from Front and Side, Showing Mechanism of "Century" Tile Machine

A Power Bending Machine

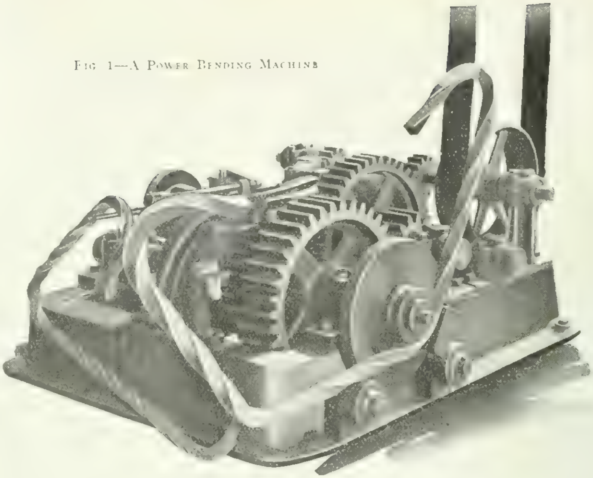
The growth of any industry can be directly measured by the development of specialized equipment required in that industry. In the concrete field, mixers replaced hand-shovels, hand-saws were replaced by saw mills, bar-benders took the place of blocks spiked to a heavy bench. The accompanying illustrations show a power-bender which has been in successful use in Cincinnati in the past three years or so, by the L. Eid Concrete Steel Co., and H. Harig and Co., contracting firms of Cincinnati; it is now being placed on the market by the Cincinnati Bending Machine Co., Cincinnati.

Fig. 1 shows the general arrangement of the machine. The power required is approximately 3 h. p., and it is belt-driven from any convenient shaft. In operating the machine, one man stands at the control lever, and two other men, usually laborers, handle the rods. The operation of bending a rod is continuous, beginning at one end of the bar, and, taking each end in succession, turns out a completely bent and hooked bar.

Fig. 2 shows the bender in operation. The bars belonging to one group are sorted on the floor in front of the bender and the foreman has the blue print in his hand and is reading off the lengths for the different portions constituting the bends. The second man with the rule marks off with chalk on one rod and when all dimensions are marked on this one rod, a chalk line is drawn across the entire group of rods.

The machine is then set for the angle required by the group of bars. It may be noted that in all beam, girder and slab work the horizontal portions of the bar are parallel. Consequently the four angles bent are equal, differing in direction only. With the angle set, the bar is

Fig. 1—A Power Bending Machine



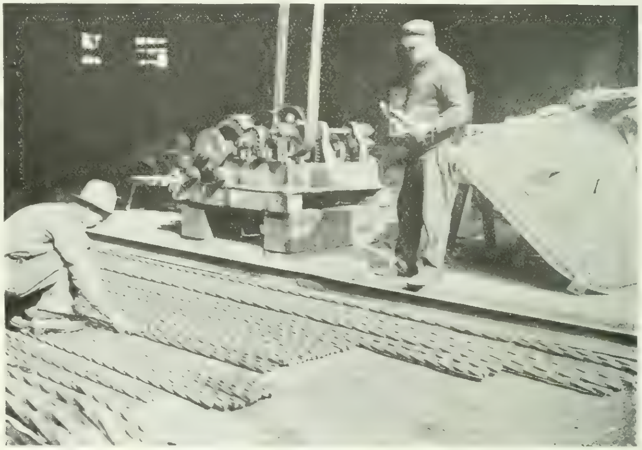


Fig. 2—Laying Out the Angles on a Group of Steel Rods of Similar Bend.

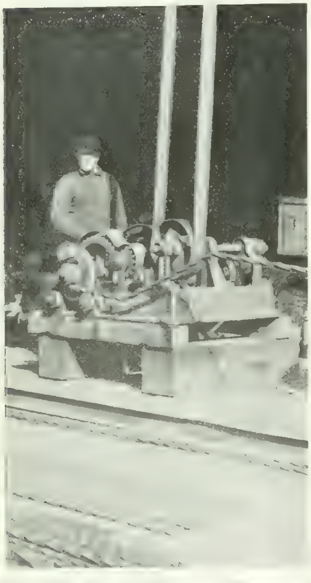


Fig. 4—The Machine Making a "C[illegible] Hook

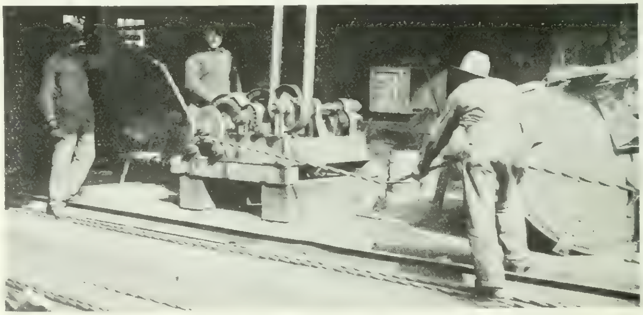


Fig. 3—Bending a Bar with a Power Machine

The bending is started at one end and the procedure is continuous until the finished bar passes through the rollers. No longitudinal reversing is necessary placed in the rollers, the man at the lever throws the clutch, and the bending crank moves with the bar until the angle is completed. At the proper point a "drip" block hits the lever, which throws out the clutch. The bending is always done in a vertical plane, and of course, the machine must be sufficiently oc he floor level to allow for the general run of bends.

The cost of bending varies with the conditions to be met. In the general run of work it can be stated that the cost of bending runs from 6c to 10c per cwt. This includes handling, tagging and loading on wagon. Timing some recent work, it was found that a bar with five bends and one hook, from the time of taking off the ground to the time it was laid down again for tagging, required 65 secs. It took 10 secs. to form the hook, which leaves 11 secs. for each bend. The bar was 1-in. square twisted. Fig. 4 shows the detail of the "Considere" hook. German tests have shown that this hook has a considerably higher efficiency than the square angle hook.

The machine is provided with an equipment for bending spirals also. Any circular bending can be done on this, handling bars up to 1" in diameter.

The machine requires floor space 3' 7½" x 4' 5½", and is 2' 3" high. Without the spiral equipment the weight is 1,900 lbs. The spiral equipment adds about 250 lbs.

* * *

Artistic Surfacing Material

An indication of the growth of the concrete products industry as well as the improved quality and appearance of the output of concrete products plants is the rapidly increasing demand for high grade surfacing materials. An officer of the Crown Point Spar Co., 663 Broadway, N. Y. C., producer of "Granite Crystals," a crushed spar rock for surfacing concrete, said recently that the demand for his product this spring had far surpassed that of previous seasons. It is roughly five years since Granite Crystals were first put on the market and in the early period of the company's history the concrete products men and contractors were slow to appreciate the necessity for using such a material to give an artistic appearance to concrete surfaces. There has been a steady increase, however, from year to year, until now orders for car-load shipments are received daily.

* * *

Business Openings Suggested

Information comes from the Chicago, Milwaukee & St. Paul Railway that there are openings for concrete block factories in several places in Idaho, Iowa, Montana, North Dakota, South Dakota and Washington; for brick plants in towns in Iowa, Minnesota, Montana, North Dakota and South Dakota, and for carpenters and contractors in Idaho, Montana, North Dakota and South Dakota. If readers who are interested will write to CONCRETE-CEMENT AGE, an effort will be made to direct them as to further information about these openings.

Concrete Fence Posts to Receive Staples

The Columbus Cement Post Sales Co., 30 W. Home St., Westerville, O., is putting on the market molds and other equipment together with special information for the manufacture of concrete fence posts, the distinctive feature of which is that staples can be driven into them with which to attach the wires. The posts are so made as to have a strip down the center of one side, composed of a material, which though permanent, permits staples to be securely driven into it. Another feature claimed for these posts is that they are very much lighter than other concrete posts used for similar purposes, and, therefore, are not only more easily handled in racking in the factory where they are made, but also on the ground where they are set in place. In the factory where these posts are made the economical system of racking makes it possible to cure from 66 to 90 posts with a floor space of only 3' x 7' 6". The standard 7-ft. post is reinforced with three ¼-in. twisted steel bars, the post itself being triangular in section. These rods are tied every foot of the length of the post with steel ties, making a frame work which is in itself very strong, and when embedded in the concrete makes a post which, it is believed, will be everlasting. The standard line post weighs about 50 lbs. The corner or end posts are 9' long with braces 8' long.

* * *

Pavement Armour Plates and Curb Bars

Fig. 1 illustrates new steel plates put on the market by the Trussed Concrete Steel Co., Detroit, for the protection of the joints in concrete pavements. These plates are made in widths of 2" and 2½" with anchor bolts cold welded of the plate and they are held so firmly on centers throughout the length of the plate and htey are held so firmly into the adjacent concrete that no amount of wear and tear is likely to loosen them. It is claimed that these plates are thick enough and wide enough to protect joints of the concrete pavement throughout its life, that the steel is of proper temper not to crack under traffic and yet soft enough to wear evenly with the pavement itself, the idea being that no unevenness is created by the failure of the plate to wear evenly with the concrete. It is also claimed for them that they are cheap enough to permit of use in all concrete pavement work. Two of these plates are used at a joint with a layer of asphaltic felt between, or a temporary steel plate may be placed between the protecting plates until the concrete has set, when the center plate is removed and the space between the protecting plates is filled with a plastic material to prevent the joint from becoming clogged with grit. Fig. 2 illustrates the Trus-Con curb bar. This is made in two sizes for different classes of work. It is made in standard lengths of 8', 10' and 12'. The larger is ¼" thick with a perimeter of 2½° with anchor bolt 4" long and 7/16" in diameter. The smaller bar is a plate 3/16" thick with a perimeter of 1¾". The anchor rod is 7/16" in diameter and 2½" long. These curb bars are not only intended for use in the protection of curbs as shown in the illustration, but also for the edges of steps and for the corners of columns.

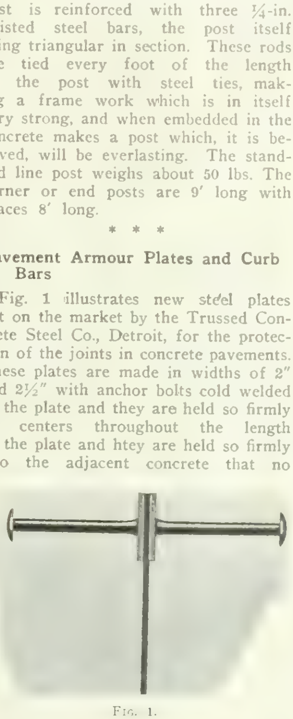


FIG. 1.

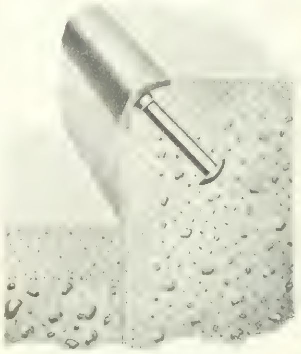


Fig. 2

The New York building regulations allow 16,000 lbs. per sq. in. on the net section of the structural steel as axial compression when the columns are thoroughly encased in concrete having a minimum thickness of 4" and reinforced with not less than 1% of hoops or spirals spaced not more than 12" apart, no allowance being made for the concrete casing. The hoops or spirals of the concrete casing shall be placed not nearer than 1" from the structural steel or the outer surface of the concrete. The ratio of length to least radius of gyration of the structural steel section shall not exceed 120.

The Ceresit Waterproofing Co., 129 S. Clark St., Chicago, has added to its organization a new department which will be called the "Superintendent Department." It is the aim of this department to superintend any structure where engineers or architects desire to have a check on the contractors on the waterproofing work. When superintendents are desired on the job, the company will be able to give bonds of guarantee of the quality of the work executed.

Meeting of International Association for Testing Materials

The sixth Congress of the International Association for Testing Materials was held Sept. 3-7, 1912, in New York[1]. The success of the Congress more than realized the greatest expectations. The governments of 20 countries were officially represented and some 300 of the 800 members had come over from Europe to attend it. The extensive final excursion over Washington, Pittsburgh and Buffalo gave the participants impressions of the technical achievements of the country, of the beauties of its landscapes, and of the hospitality of its inhabitants, which will never be effaced from their memories.

The Leipzig Exposition: Building materials and their testing will be one of the prominent features at the International Exhibition of the Building Trades in Leipzig, which is to give a clear notion of the entire realm of building and homes in its scientific, artistic, social and economic significance. It will be composed of the following sections:

I. Architecture.
II. The Literature of Architecture and Building; Technical Educational Institutions; Office Requisites for Architects and Engineers.
III. Building Materials, their Manufacture or Preparation and Use.
IV. Machines, Tools, and Apparatus used in Building.
V. Sale and Purchase of Building Land; Building Finance; Estate Agencies; Insurance in Connection with Dwelling Houses; Book-keeping for Builders and Architects.
V. Building Sanitation for Dwellings, Factories, and Streets; Protection of Workers from Injury; First Aid and other Provisions for their Health and Comfort; Precautions against Fire; Old Age and Invalid Insurance.
VII. Gymnastics, Games and Sports.
VIII. Testing of Building Materials; Technical Demonstrations.

Reinforced Concrete Building Accidents: With a view to preventing accidents and facilitating the acquisition of the requisite knowledge of the properties of materials, it seems advisable that a uniform system of reporting on building accidents should be adopted in the different countries, in the same manner as is already done in the case of accidents to steam boilers. The sixth Congress expressed a desire that Committee 41 shall endeavor to organize such an international system of reporting, and to present to the next Congress a report on building accidents collected country by country, together with the deductions made therefrom as regards the prevention of accidents.

Fire-proof Building Construction: RESOLVED: I. That it is advisable in the future investigations of the strength of concrete and of reinforced concrete as used in buildings, to obtain reliable data on the effect of fire at high and at moderate temperatures upon these materials.

II. That the data required should refer especially to:

1. (a) Loss of strength during fire.
   (b) Loss of strength after a fire. (Both upon rapid cooling and natural cooling.)
2. (a) The value of different aggregates and the proportion of Portland cement to the aggregates.
   (b) The value of different forms of reinforcement.

III. That tests conducted with the view of obtaining these data in different countries be arranged as far as possible on a uniform basis, the universal standards for fire tests of the British Fire Prevention Committee adopted at an international Congress in 1903 to serve as far as practicable as a basis for the testing conditions, these conditions having also been largely applied in the tests of the Columbia University testing plant at N. Y. C. and elsewhere.

IV. That the Council of the International Association for Testing Materials create a special sub-committee (under Group B, Cement, Concrete, etc.) to deal with any problems arising out of the foregoing, to be known as the Sub-Committee on the Fire Resistance of Concrete and Reinforced Concrete, and that this sub-committee be requested to report at the next Congress.

Testing Road Materials: That the Congress be asked to create a committee for the unification of the methods of testing materials for roads and of the nomenclature of such materials, this committee to work in collaboration with the Executive Bureau of the International Roads Congress.

Progress on New York Building Code

The Committee on Buildings of the Board of Aldermen, N. Y. C., is preparing to report on a proposed building code for the city of New York. After procuring an appropriation for that purpose the committee has secured offices at 51 Chambers St., where a series of hearings will take place in April, at which all people interested in the various sections of the building code will be heard.

The Joint Committee on City Departments, representing the various building trades, architectural associations, etc., has submitted a list of architects, engineers and contractors, many of whom prepared the report that was introduced in the Board of Aldermen about a year ago. In addition to the names submitted by the Joint Committee on City Departments, the Committee on Buildings of the Board of Aldermen has appointed a number of architects, builders and engineers to assist in preparing the report at an early date. Abram W. Herbst, is chairman of the Committee on Buildings.

A New "Universal" Plant at Duluth

The Universal Portland Cement Co., a subsidiary of the U. S. Steel Corporation, has started work on the construction of Plant No. 7, at Duluth.

This plant will cost about $1,700,000 and will have an output of 1,400,000 bbls. of "Universal" Portland cement per annum. The plant will be electrically operated throughout, requiring about 5,000 h. p. Edward M. Hagar, pres., states that work will be pushed as rapidly as possible, and it is expected that the plant will be in operation in 1914. With its present plants at Chicago and Pittsburgh, this will give the company a total output of 45,000 bbls. a day, or 13,500,000 bbls. a year.

The shipments of "Universal" Portland cement in 1912—10,047,499 bbls.—exceeded those of any cement company in the world.

It is interesting to note the growth of this company, as well as the percentage of its output, to the total American production, as shown by the following table:

Year	Cement in Portland Production of U. S. Bbls.	Production of "Universal" Portland Cement. Bbls.	Percentage of "Universal" to Total American Production.
1900	8,482,020	32,443	.39%
1901	10,711,225	164,316	1.29%
1902	17,230,644	318,710	1.85%
1903	22,342,973	462,930	2.08%
1904	26,505,881	473,294	1.78%
1905	35,264,812	1,735,343	4.92%
1906	46,463,424	2,076,000	4.55%
1907	48,785,390	2,129,000	4.36%
1908	51,072,612	4,535,000	8.89%
1909	64,991,431	5,786,000	8.92%
1910	76,549.951	7,001,500	9.14%
1911	78,528,637	7,737,500	9.85%
1912	81,941,998	10,114,500	12.34%

The New York building regulations require that the axial compression in columns with not less than 1% of hoops or spirals spaced not farther apart than 1/6 of the diameter of enclosed column and in no case more than 3 in., and with not less than 1% or more than 4% of vertical reinforcement, shall not exceed 725 lbs. per sq. in. on the concrete within the hoops or spirals, nor 8,700 lbs. per sq. in. on the vertical reinforcement.

The National Good Roads Federation, J. A. Rountree, secretary, will hold a meeting at Birmingham, Ala., April 24-25, when it is expected that representatives of many states interested in the Good Roads movement will be present. The idea is to get concerted action on the part of Congress for federal aid.

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[1] Pp. 55-59, Oct., 1912

Concrete-Cement Age

Vol. II MAY, 1913 No. 5

Editorials

WHY, AND we have asked it often, should anyone expect concrete construction, whether used in walls only or throughout the work, whether in monolithic or unit form—why should anyone expect this permanent, fireproof, weather-resisting material to compete in price with flimsy, firetrap, moisture-absorbing construction? Concrete construction is by far the cheapest permanent construction, even on a basis of first cost with no consideration of the avoidance of heavy repair and maintenance charges which its use makes possible, and in many favored localities and under competent supervision, concrete construction will give even the flimsy construction a close contest on the short-sighted, first cost basis. But, why, why should it be expected to do this? Concrete is best at the highest cost, but it is possible to have it even at very near the lowest cost.

* * *

THERE ARE some interesting concrete road cost figures on page 223, supplied by A. N. Johnson, state engineer, the Illinois Highway Commission. Four roads are reported, the McLean, DeKalb, Springfield and Carlinville jobs showing a sq. yd.-cost of $0.793, $0.818, $1.035 and $0.817 respectively. The total square yardage on each job varies from 5,000 for the McLean work to 7,334 for the DeKalb contract. Lengths of haul varied from $\frac{1}{8}$ mile on the McLean and Springfield work to $1\frac{1}{2}$ miles for the sand on the Carlinville work. Thickness of pavement varies from 6" to 7". Enough has been published in previous issues as to Mr. Johnson's methods in concrete road construction to make it a fair presumption that all the work was well done. This seems very much like a permanent road construction which is not a luxury in any fairly busy community, but *a necessity which it were an extravagance to be without.*

* * *

ONE MIGHT almost suppose from the apparent unwillingness of the producers of concrete stone to discuss with the architects the development of their products for the better uses of architecture, that they had matched the achievements of Alexander and had no more worlds to conquer. Many concrete products manufacturers have seen the possibilities in the larger and more effective uses of their material and are successfully meeting the demands of architects. There are others who are content to turn out units for the construction of basement walls. And while we would not detract from the importance of good units for even such inconspicuous use, we insist that many architects are but waiting to have presented to them the units for the very best of their work. Why shouldn't the concrete stone makers tell the architects through this journal something of their progress in their important industry and indicate their preparedness to supply the units which the architects want? Of course, the architects and the builders will ultimately find their way to the door of the shop where superior products are made, just as someone has it that the world will make a beaten path to the maker of the best mouse-trap. This method of achieving success in the building world, however, is slow.

* * *

SPEED IN construction is the rule with firms of concrete constructors who have carefully analyzed field costs. In past issues, descriptions of speed records made have been published, and a review of building construction for the past few years would show that the "story-a-week" record is very common. In this connection, we offer two suggestions: We should like to publish descriptions of speed records in *small* work, such as small buildings, sidewalks, and similar structures. We should also like to point out the fact that fast work is usually efficient and profit-making construction. To complete a job in the shortest time consistent with good work means that the men and the plant are ready for other work and the final estimates are due. Capital is invested in office overhead, general expenses and plant. Rapid work means turning this capital over the greatest number of times within a season. It means a profit by aggressive, time-saving energy.

* * *

Clay Publishers Exhibit Craftiness

For real craftiness, the clay papers are in a class by themselves. One of them announces the institution of a new magazine, to be devoted to planning, building and furnishing high-class homes. The publishers admit that there are many magazines already in this field and say that "many of them are excellent from their viewpoint." It appears, however, that the viewpoint is wrong—burned clay as a building material receives very little credit. This shameful lack, the prospective publisher of the new magazine points out, is due to the sordid nature of publishers already in the field. He is shrewd enough to make some very acute observations. Listen: "The publishers of these magazines are running their magazines to make money—not to lose it." The inference is that there is something inherently scandalous and debased in this policy. Further: "If the lumber man and the concrete man take the bulk of the advertising, lumber and concrete is (*sic*) going to predominate in the reading columns and burned clay is going to take a back seat." This calls instant attention to the perverted notion of some of us who feel that if we are honest in printing advertising at all in the first place, we are equally honest in giving our readers information about the things advertised. Not so the brick paper publisher—not at this stage of the game.

But the scene shifts very suddenly in another paragraph. It appears that the prospectus-writer is human and alas! selfish, too. Quoting again: "The publishers of * * * (a clay paper) knowing that a publication that will go into the hands of the buying public and which will boost brick to the exclusion of all materials, will be a benefit to the brick-makers and, in the long run, a benefit to this journal, proposes (*sic*) to take up the editorial work outlined." The sentence is a little involved and ungrammatical, but it comes from the heart, sure enough.

More is coming from the prospectus. Hark! This is addressed to present readers of the clay paper, who are evidently not considered as prospective readers of the new magazine: "With one hundred thousand readers receiving the lessons of burned clay each month, think what a great army of boosters you might have!

"While we have impressed upon you the fact that '—— ——' is going to be a most readable paper and one which any person may be desirous of reading, do not overlook the fact that primarily it is intended as a boost for clay products.

"The only motive that prompts its publication is the fact that it will be the greatest publicity feature possible for clay products.

"Naturally, this purpose will be disguised.

"The contents of the magazine will be so edited as to keep this idea the farthest away from the reader, and whatever is said about clay product will be in a natural way." We bet that it won't, but let that pass.

Here is the prospectus, much abridged and stripped of display type. The clay paper's readers are urged to assist in giving the new magazine a circulation of 100,000 before the close of 1913. This seems like a sizable task, but nothing daunts the clay publishers. We confess to a lively interest in the enterprise as outlined. A brand-new magazine, practically a house-organ for the clay interests, with no object (see prospectus) except the increase in use of clay brick, with a circulation of 100,000 in less than a year—at $3.00 per year—will be a paper worth looking for. Its editorial purpose is to be so disguised that the simple-minded reader will not know that he is reading boosts for clay products, while all the time he is to absorb through his mental pores the notion that clay and clay alone is the only building material. We had not supposed that there were in the world 100,000 readers of so small a mental caliber. We shall welcome the first number of this remarkable literary treat

* * *

Inspectors on Concrete Construction

Concrete work should be carefully inspected; of that there is no doubt. Who the inspectors should be, however, is still an open question. Should the responsibility for the successful execution of the work be placed on the owner alone, through his architect or contracting engineer, or should the city or state authorities step in and require that all work be done under the inspection of public officials, construction policemen, as it were? An interesting sidelight is thrown on this question in the report of the Los Angeles building ordinance commission to the Los Angeles City Council and the comment on city inspection of concrete work by a Los Angeles architect, published in other pages of this issue.[1] Speaking for the engineering fraternity as a whole, and for individual responsibility in general, the architect's protest is well expressed. Public supervision is, of course, to be desired, but when this becomes detail inspection and, to a certain extent, direction which has to be paid for by the owner it is unfair, unless it carries with it a certain degree of responsibility which under present laws our cities cannot assume. Rigid requirements, with heavy penalties for failures, and placing the responsibility where it belongs will probably do more than detail inspection.

* * *

Scientific Shoveling; Technique of the Shovel

Frederick W. Taylor, efficiency expert, has determined after a careful and definite study that the average first-class man with a shovel does his best work when he is handling 21 lbs. to the shovelful. This discovery opens an important field in implement differentiation. The employer who wants to be certain that his employes are doing a maximum day's work at a maximum of staying power will do well to give this matter some attention. Mr. Taylor's conclusion is absolute—the result of long continued and carefully checked observations, made by trained men. Heads of operations requiring continued hand shoveling—laying concrete roadways, for one example—will find it economical to have their gangs furnished with hand shovels of capacity exactly suited to the material in which they are working. A man handling sand with a shovel adapted to use in crushed stone is wasting both his time and his energy, to his own and his employer's disadvantage. A shovel, properly designed, so that the worker lifts 21 lbs. of sand, or 21 lbs. of crushed stone is nomally being used at maximum efficiency. Shovels are being made for use in everything from rice coal, where about 3½ lbs. used to make an average scoop shovelful, to wet ore, with about 38 lbs. to the old shovelful. There are shovels that conveniently hold 21 lbs. of rice coal or 21 lbs. of wet ore, or 21 lbs. of sand, or 21 lbs. of crushed stone—and it is economy to buy them and to equip your men with them.

So comparatively unknown a subject as the "technique" of shoveling has also had Mr. Taylor's attention. He announces that the most efficient method of shoveling is to put the right arm down on the right hip hold the shovel on the left leg and when thrusting into the material to be shoveled, throw the weight of the body on the shovel. This is not only the most efficient way, but it is also the easiest for the men.

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[1] "Inspection of Reinforced Concrete," p.

Poured Concrete Houses in France

Forms for the Entire Building Are Set Up and Casting Done in One Operation

For many years it has been recognized that the development of low cost concrete house construction is a problem of mechanical engineering. We must devise forms and methods of handling concrete which will bring to the small individual structure the economy and efficiency possible in larger work. The problem of forms has been especially the subject of much attention. Steel is rapidly replacing wood and while this development has been mostly along lines of small unit plates and pouring a comparatively small course of concrete at a time, yet there have been other developments leading slowly but surely toward more radical methods of handling problems. In other pages of this issue[1] a system of steel wall forms is described in which an entire story is centered and cast at one operation.

Several years ago experiments were made to determine the possibility of placing the molds for an entire house in one operation, and, with a concrete which had been rendered exceptionally fluid by an addition of colloidal matter, pouring the concrete all at once. The engineers who performed the original experiment along these lines, meeting with little encouragement in this country, transferred their operations to Europe, and in *Cement Age* for Feb., 1912, is published a complete account of the first pouring of such a structure at Santpoort, Holland, in the fall of 1911. The engineers, Messrs. G. E. Small[2] and H. J. Harms, Jr.,[3] following the success of their first work, have extended operations to France and to this country, and seemingly revolutionary as this idea is, yet it is meeting with marked success as an efficient and economical process of house construction.

It is needless in these paragraphs to state the advantage of concrete dwellings; not only is the maintenance low and their satisfactory permanence practically assured, but they are fireproof, earthquake proof, and, if well made, damp proof. Associated with the solidity of the strength of the monolith may be found every beautiful and attractive feature that the skilled architect can contrive for the greater convenience, the more pleasing and the richer adornment of our modern homes.

This system of construction is, of course, patented in both the U. S. and European countries. In France there is now a company in successful operation and the accompanying photographs illustrate some of the work recently completed. The method as a whole comprises two essential features. The first of these covers the method of forming the molds. The cast iron segmental plates are erected for an inner and an outer wall. Taper bolts are used which not only hold the wall together, but act as spacers to keep the molds at a uniform distance. The bolts are also used to hold the reinforcing in place until the concrete is cast. The bolt holes left when the centering is dismantled are filled with concrete.

The floor and roof slabs, window and door frames and any steps are of precast concrete and are placed in connection with the molds at the time of their erection. By thus making floor and roof slabs and the steps in advance and placing them as erection proceeds, no extra molds are necessary.

It also allows the forms to be removed very shortly after the concrete is cast and does not require any shoring or centering of any kind under the floors. It can thus be seen that the use of pre-cast horizontal parts of the structure facilitates the speed of completion. When the molds are removed the structure is 90% completed.

An essential to this method of construction is that the concrete itself shall

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[1] p. 255

[2] 80 Wall St., N. Y. C.

[3] 6 Bv., Haussmann, Paris

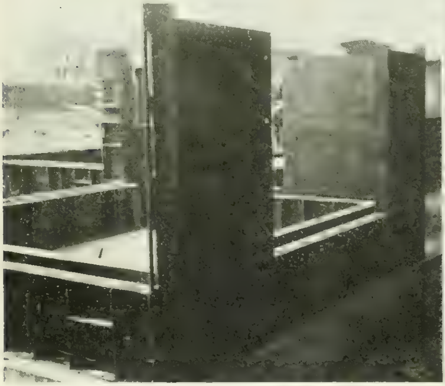


Fig. 1—Cast-iron Segmental Centering Up Part Way in Starting a House Structure

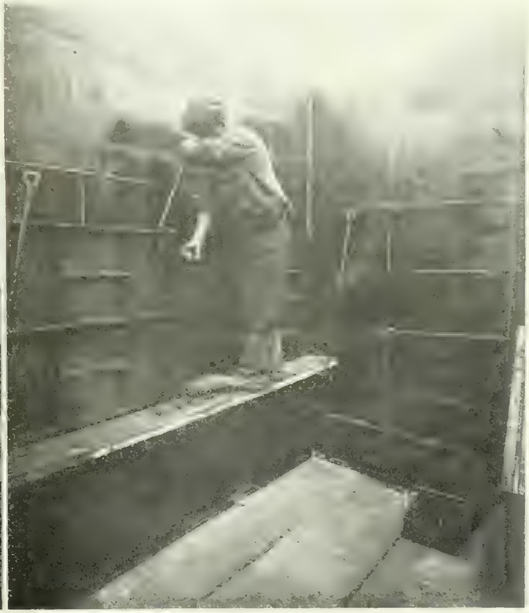


Fig. 2—Mechanic Placing Cast-iron Segment for Inner Wall

flow very readily. To the usual concrete mix, 1:2:3, using stone or gravel, a certain quantity of clay is added by dissolving it in the water used for gauging the concrete. The clay so used is a definite factor, as the addition of it to the water is governed by means of the hydrometer. It is this addition of the clay that allows the concrete to be of such composition that it is very fluid and at the same time remains homogeneous and very dense. The addition of the clay contributes to the density of the concrete for it fills the voids in the cement in a manner very parallel to the way in which the cement fills the voids in the sand and stone.

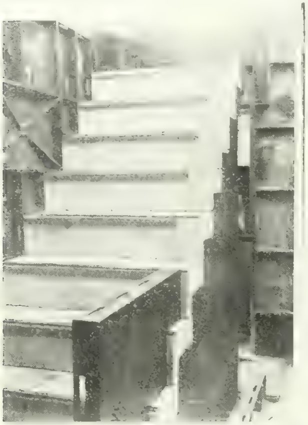


Fig. 3—Precast Concrete Stair Units in Place Resting on the Cast-iron Forms

While this mixture is richer than is ordinarily used, it is worth while, for it has been found that the concrete produced is impervious to water. From tests made at a French laboratory, by H. Mesnager, ch. eng. of Bridges and Public Works, France, this concrete gave very satisfactory results in both compression and adhesion. It crushed at the age of 7 days at 75 kg. per sq. cm. (1,065 lbs. per sq. in.). This is equivalent to the requirements in Paris for soft building stone.

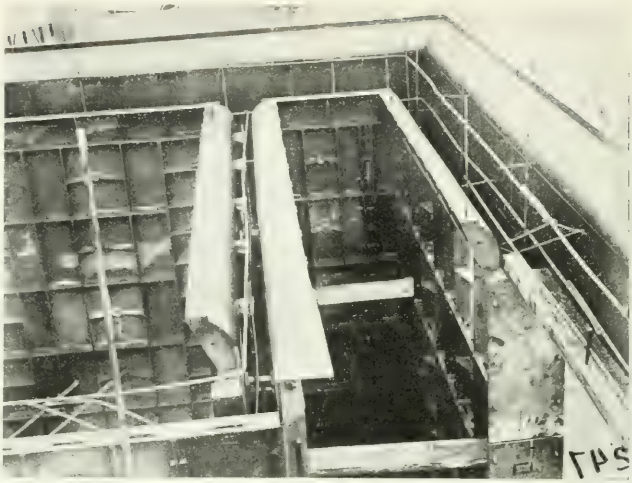
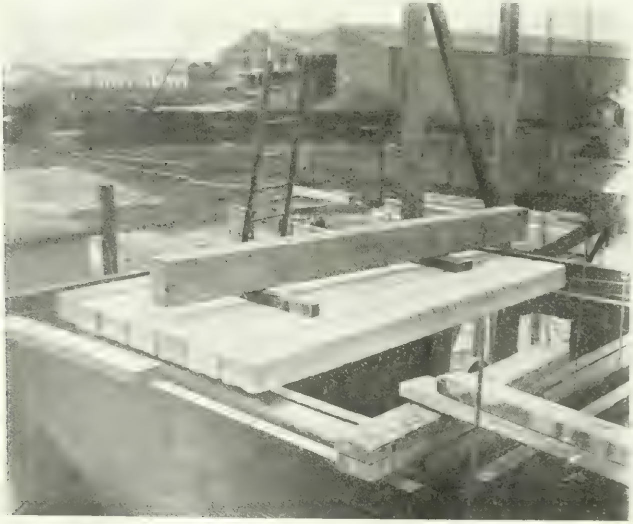


Fig. 6—A Detailed View of Fig. 5 Showing the Cornice Molds

Such a house constructed of poured concrete will cost, it is stated, approximately 20% to 22% less than a similar structure of brick and stone. The firm of Harms and Small, Paris, is at the present time building 120 houses at Salindre, in southern France. The bid submitted on this work was applicable to either Parisian district or the provinces and was as follows:

	Parisian District	Provinces
Ordinary construction (brick or stone)	$1,773	$1,826
Poured concrete	1,314	[illegible]



—[illegible] Floor Slabs in Place

The accompanying illustrations probably make the process clearer than any text. It may be briefly stated that the forms themselves are segmental cast-iron plates, bolt-connected through slots. The largest unit used is 16" x 32" and weighs 75 lbs. It can be handled by one man. Fig. 1 shows a set of forms partly erected. This shows plainly the connections at the top and the bottom of the plates made by heavy bolts through the slots. In Fig. 2 are shown the forms for the outside wall up. The reinforcing steel is in place and wired to the tapered bolts going through the plates. It is of interest to note that the bolt holes are in the center of the plate sections. The mechanic is adjusting the cast-iron plates, using a pry equipped with a sliding hook, and spanner wrenches. The scaffolding on which

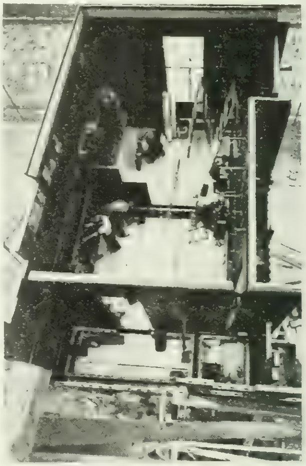


Fig. 5—A Bird's-eye View of a Residence Under Construction Showing the Two Floors in Place and the Outside Forms Erected to the Cornice

he is working is supported by brackets attached to the cast-iron plates. The inner surfaces of the plates are well oiled.

How the steps are placed is plainly shown in Fig. 3. These are pre-cast units, each unit being a complete step. The unit is essentially a rectangular, hollow step with a steel protecting angle at the wearing edge on each step. The steps are so arranged that they overlap each other, making them much stronger and more easily erected This view also shows plainly the slots on the flanges of the plates through which the connections are made. The method of floor construction is plainly shown in Fig. 4. Pre-cast, rectangular, hollow floor slabs are placed on top of the cast-iron forms, projecting over the cove formed at the ceiling line. These floor units are cast in separate forms. They are made hollow by using collapsible cores, following much the operation of the Siegwart system.

A bird's-eye view of the structure is shown in Fig. 5. This shows the concrete floor slabs in place for the second story and the outside forms erected up to the cornice. The wall steel is in place and the erection of the molds is being rapidly completed. Fig. 6 is practically a detailed view of Fig. 5, and shows the molds for inside and outside walls completed to the cornice line.

After the roof slabs are in place the structure is ready to pour. To do this a hopper is erected on a scaffold above the roof level and concrete mixed in an American made batch mixer[4] is hoisted up in a bucket and dumped in this hopper. The concrete used is very fluid; it will flow on cast-iron on 2½% slope and flow on itself at 1% slope. It seeks its own level very readily. Fig. 7 is a detailed view of the hopper above the roof of the building. A home-made chute is used and at the time the photograph was taken concrete was passing down the chute.

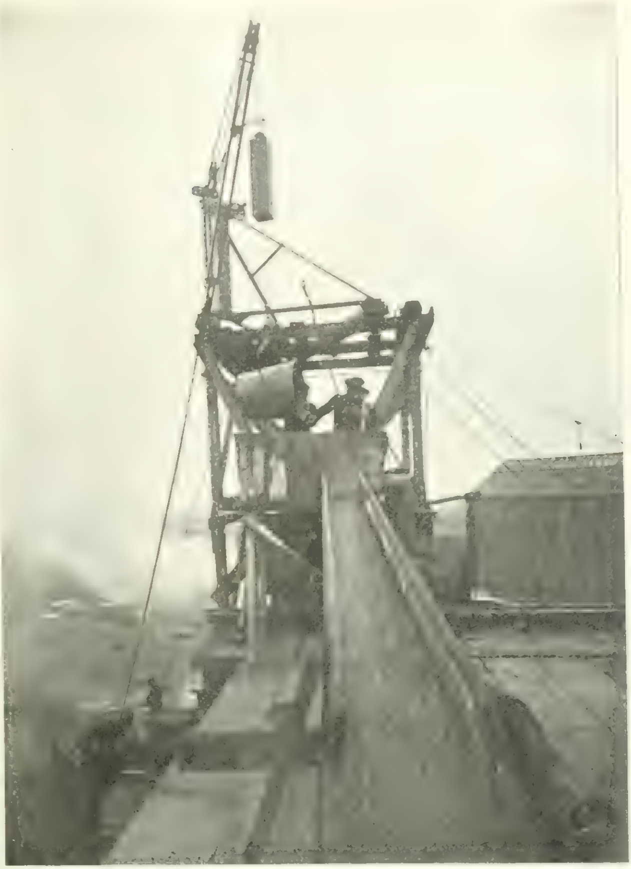


Fig. 7—Pouring the Concrete [illegible] Entire House at One Operation

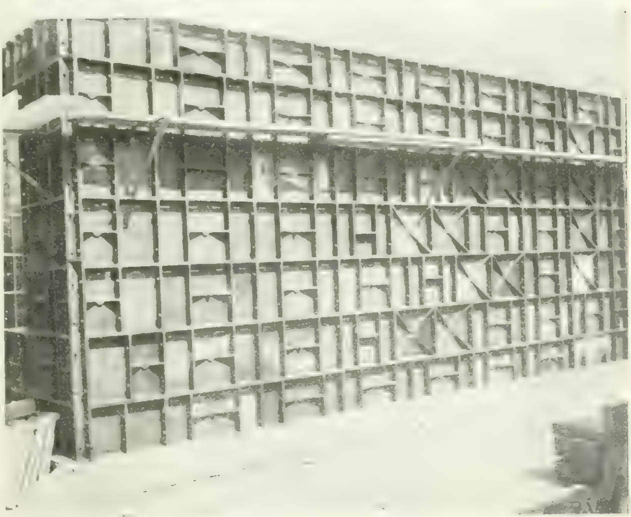


Fig. 8—An Exterior View of the Centering Completed

A striking feature of this system of forms is the entire lack of any shoring, bracing or ledgers. This is strikingly illustrated in Fig. 8, which shows the outside of the house ready for pouring. A close inspection will show the way in which the sun shines through the slots of the top and the bottom flanges of the plates. In Fig. 9 are shown the forms being dismantled. Apparently the scaffolding shown in Fig. 8 is left in place so that the plates can be removed as soon as the concrete is hard. Mechanics unbolt the segments and they are lowered to the ground by hand. In Fig. 10 the drawings, plans, elevations and section are shown. The completed house is shown in Fig. 11. The surface can be washed down immediately after removing the molds to eliminate the traces of the panels.

As to the cost of these molds, the inventors state that a complete equipment of molds sufficient to pour a house of five or six rooms costs approximately $10,000. Basing depreciation on 20

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[4] Smith mixer, T. L. Smith Co., Milwaukee

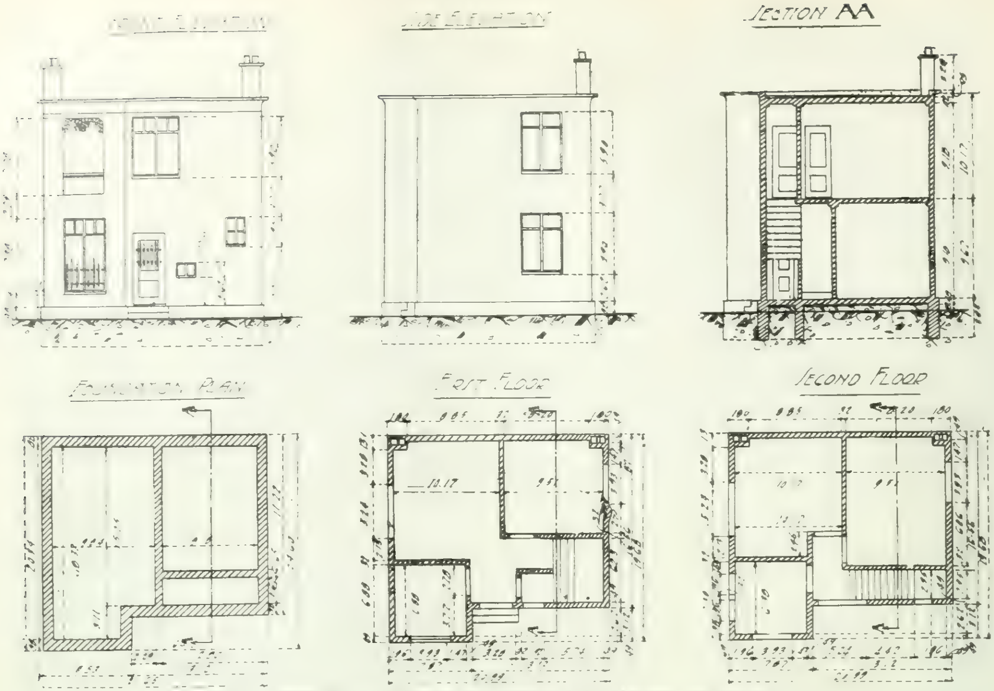

FIG. 10—GENERAL DRAWINGS SHOWING THE HOUSE IN PLAN, ELEVATION AND SECTION

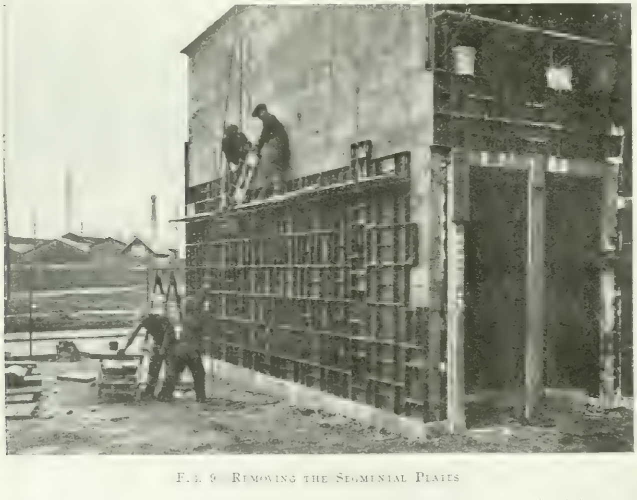

FIG. 9—REMOVING THE SEGMENTAL PLATES

years' service, which seems rather a long time in the concrete field, where everything has changed so rapidly, the depreciation per year is $500 and by building 15 to 25 houses every year, the form cost per house is from $20 to $35. The economy of the forms varies directly with the number of structures for which they can be used. In comparing them with wood forms, the items of transportation, storage and interest on investment must not be overlooked; and, on the other hand, such a system of cast-iron forms and "one-operation" erection offers economy in labor and time, which should go far toward counterbalancing the rather high initial investment required.

For American concrete engineers, this system, which will probably be in operation in this country before very long, presents radically interesting features. In the first place, a well-formed centering unit is used so heavy that when it is bolt-connected at the flanges a rigid surface is furnished. The second radical feature is the combination of poured concrete and pre-cast concrete, which seems to offer many interesting possibilities in economy and efficiency. The next feature is the method of centering for an entire structure at one operation. This concentration of labor along one line until that line is finished should make for better speed and less cost when considering the structure as a whole. Involved in this last point, of course, is the consistency of the concrete used. A careful consideration of all these points brings home very emphatically the possibilities offered by such methods of procedure. While they are, in a way, revolutionary, yet they are following lines of good development. Further developments will be watched with interest.

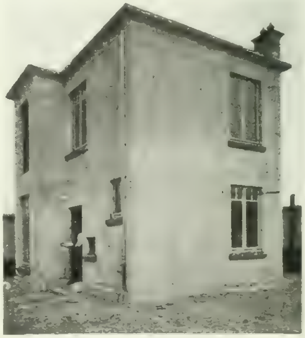

FIG. 11—THE COMPLETED STRUCTURE

Molding Sand Cores for Floor Construction

Concrete Cast over Sand Cores Produces an Artistic Ceiling and an Ideal Floor

BY FREDERICK SQUIRES*

I have never known a subject where, more than in this sand-molding of concrete into ceilings, the work of the architect and the engineer has been more closely joined. Never have I seen a better opportunity for the engineer to play into the hands of the architect and the architect to design along structural lines. To the architect this scheme of embellishing his ceiling is nearly as old as his art and has persisted to the present day as one of the most potent principles of design. The Basilica of St. Paul at Rome here illustrated (Fig. 1), is a splendid mastery of coffered ceiling design, and in the recently completed Avery building (Fig. 2), housing the School of Architecture at Columbia University,[1] McKim, Meade and White[2] have given us a modern illustration. From the point of view of appearance, designers have agreed on its effectiveness for 2,000 years. Its engineering popularity, especially in reinforced concrete, is of present date and is due, in the case of concrete, to a physical characteristic of the material. The structural economy in a coffered ceiling is due to the fact that, for a beam or floor in flexure, while the compression and tension are equal, a greater area in section or bulk of concrete is required in compression than the balanced tension requires in steel. Concrete is required in the upper portion of the slab and steel in tension in the lower part, and, as the concrete in the lower part of the slab or beam is required as a protection to the steel and ing this article are uesd through the to tie it in only, the less concrete used, the better. Hence the many developments in various cored floor systems, using tile, sheet metal or fabric cores. Just as the framing of wooden floors began by running beams in one direction parallel to each other and supported on two walls, and developed by running a few continuous pieces at right angles to them so that they would help each other by acting together, so parallel concrete beams were cross-bridged first with a few and finally with an equal number of transverse beams. It was found that a result was obtained by cross beams, monolithic with themselves and the top slab, almost equal to a solid slab of like thickness and with a striking economy of concrete over the solid slab. This economy has been in the past lost to a great extent in the cost of the elaborate timber form work which was necessary. This excess cost, coupled with the desire for a flat ceiling, led to the use of permanent tile and metal forms now in such wide use. The material we are now concerned with, molding sand, is everywhere available and so cheap and adaptable that the bug-bear of costly form work is removed. In addition, there is provided a medium by which the age-long desire of the designer for a molded coffered ceiling may be satisfied.

In this day of moral awakening, it may not be amiss to emphasize the sincerity of this kind of design. It tells the truth, the whole truth, and nothing but the truth. The engineer lays out his construction with due regard to the required loads. He figures his steel; he figures his concrete. His attitude is that of a general marshaling his forces in just the positions and just the numbers in which the crisis of battle will require them. He has been influenced by no other consideration than the require-

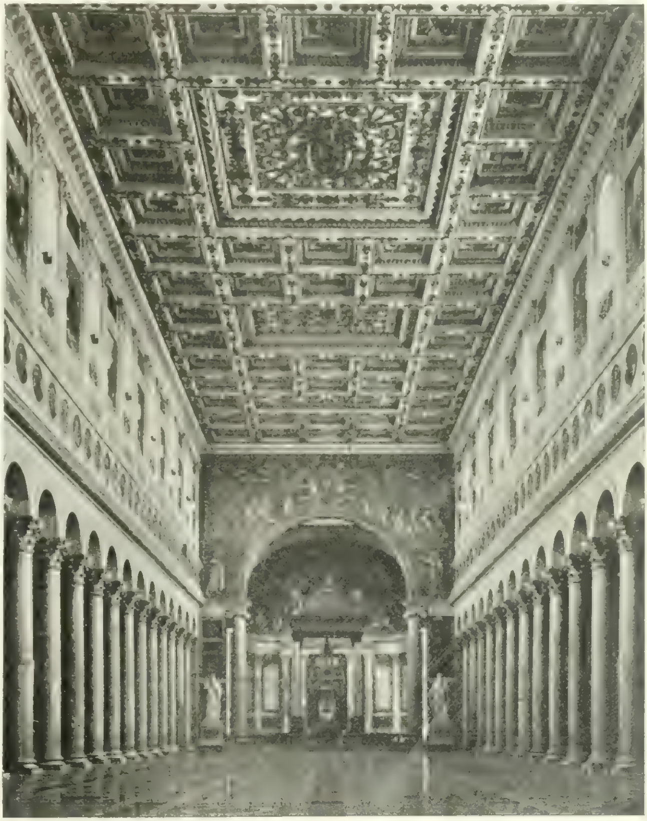

Fig. 1—The Coffered Ceiling in the Basilica, St. Paul's, Rome.

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*Architect, N. Y. C.

[1] N. Y. C.

[2] Archs., N. Y. C.

[Note—The illustrations accompanying this article are used through the courtesy of *Architecture and Building*, N. Y. C.]

ments as he sees them. Then the architect, without changing a line of the engineer's arrangement, molds and decorates his outlines and a construction useful and ornamental and altogether truthful is the outcome.

The ancients used wood beams, and their successors of the Middle Ages used plaster imitations of wooden designs. Plaster has persisted as a ceiling covering, but flat rather than decorated ceilings have become the vogue and have developed the flat fillers before mentioned. Personally, I think that plaster, compared with concrete, is over-rated artistically as a suitable covering for ceilings. In my practice I very generally avoid the cold effect of hard-finished plaster. Wherever a client will allow it, I finish the plaster with sand to give it interest in color and surface. If I don't sand-finish it, I always strive with my color and its application to give the effect of texture, that is, of minute roughness. It is quite striking that there is nothing in the harmonies of nature which gives the effect of a glazed surface like hard plaster. I have remarked many a time how much more beautiful is the surface of a concrete vase than the plaster model from which it was reproduced. This is because concrete has that texture and color which is so totally absent in hard plaster. Plaster is an excellent molding material, but so is concrete. Concrete has advanced, plaster has stood still. With the introduction of light-colored cements, the charm of cast concrete has advanced by leaps and bounds. It always had texture, now it has color. I have seen reproductions of ancient marbles in concrete which need feel no disgrace standing beside their noble ancestors. I have seen colors in concrete the like of which for beauty no stone ever possessed.

When a room is to be architecturally embellished, be it a big room or a little one, of all its six surfaces it is the ceiling to which the greatest attention is devoted. This is as true as the fact that for 2,000 years the ceilings have been treated in very much the same way. The interest in the side walls usually increases from the floor up, and blossoms in the ceiling. St. Paul's, Rome, here shown, is a splendid illustration. So is

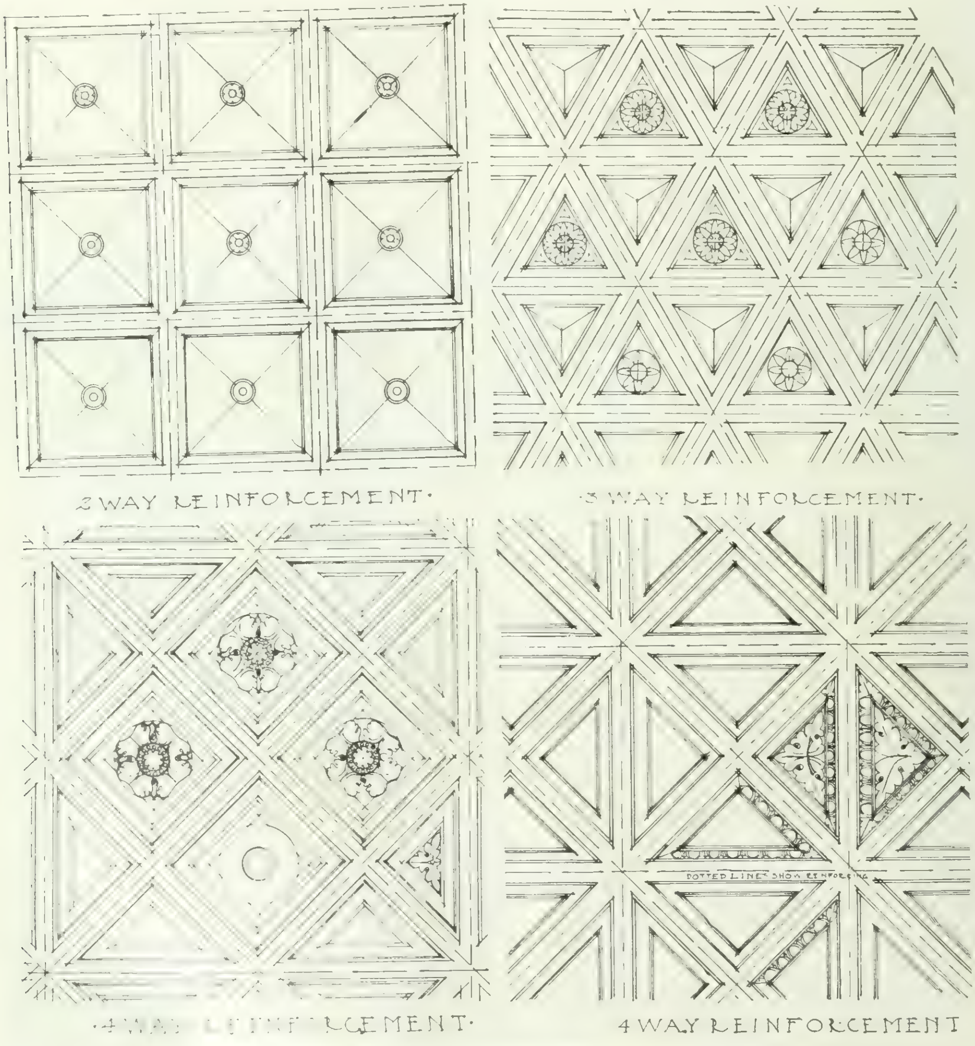

Fig. 3—Sketches Showing Suggested Arrangement of Paneled Ceiling Cast Over Sand Molds

the waiting room of the Pennsylvania station in New York and the reading room of the New York Public Library. In a lesser degree, but just as truly it may be seen in the city mansion and the country house. This axiom makes the ceiling a good field for elaboration with sand molding. The difference in cost and the similarity in result between carving stone to a given contour, and pouring a liquid mass over the reverse of that contour is indicative of the possible utility of the latter method. In pouring a concrete floor over a paneled sand matrix, lovely colors are easily obtained; since concrete is a combination of cement, sand and stone, and since there are many varieties of each, the possible combinations are bewildering. It is then with concrete that we are going to wed engineering and architecture in sand molded ceilings.

This method of construction involves in a single process, casting the structural slab, and molding its under surface into a coffered architectural ceiling. On temporary wooden centering, pallets covered with molding sand are placed, reinforcing steel is laid into the spaces between the molds and concrete is poured between and over the sand piles and allowed to set. Then the centering, pallets and sand are removed and a ceiling displayed in the inverse image of the molds. In the modeling quality of the sand, its curing ability, the temporary fluid quality of the concrete and the simplicity of casting in bas-relief, lie the virtues of sand molding.

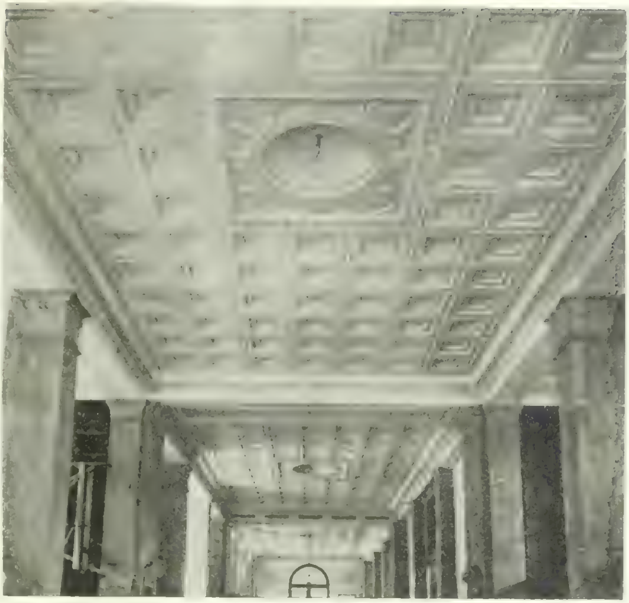

Fig. 2—The Ceiling of the New Avery Hall in the School of Architecture, Columbia University

Fig. 3 shows the myriad possibilities for combination of forms that may enter into such a ceiling. Practically the only limitation is that each beam represents a reinforcing rod which should go from one support to another, requiring, of course, a design with continuous straight lines. To every concrete man will suggest itself some new way to use the scheme, some new combination of aggre-

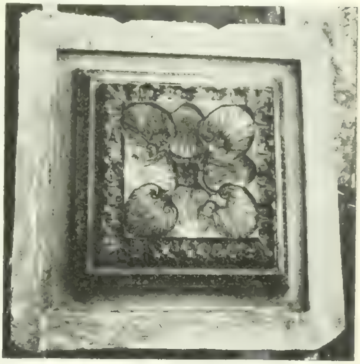

Fig. 4—Plaster Negatives Used for Glue Matrices.

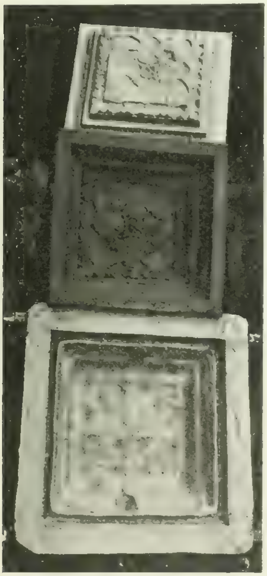

Fig. 5—Detail of the Plaster Impression, the Glue Mold and the Plaster Casing Used to Hold the Glue Mold in Place

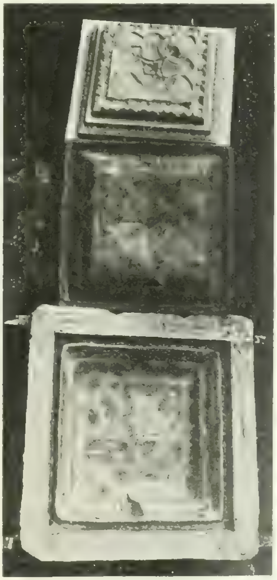

Fig. 6—This is the Same as Fig. 5, Showing the Reverse Side of the Glue Mold

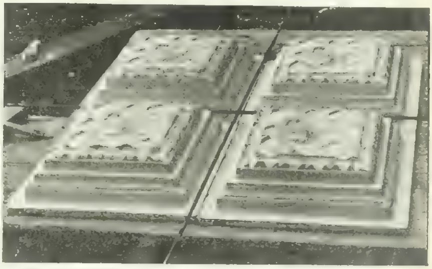

Fig. 7—Detail View of Preliminary Experiments With Plaster Molds

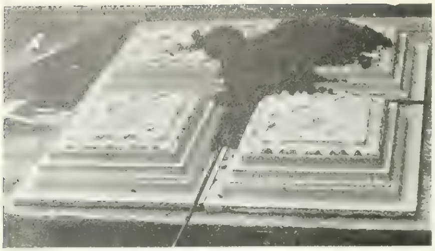

Fig. 8—Showing the Method of Placing Concrete in the Preliminary Experiment Plaster Molds

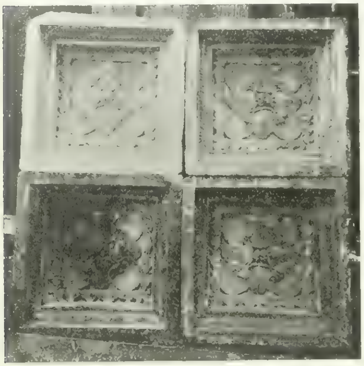

Fig. 11—Pre-Cast Permanent Forms in Concrete and Plaster

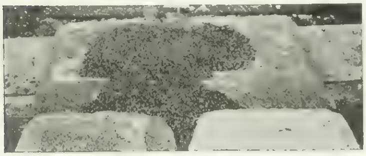

Fig. 12—The Pre-Cast Permanent Forms in Plaster in an Experimental Slab

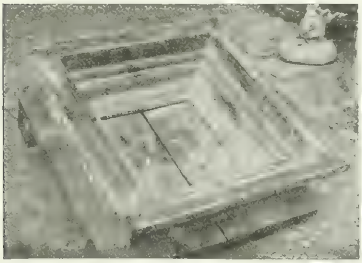

Fig. 14—Wooden Casing Used to Hold the Plaster Positive for the Sand Molds

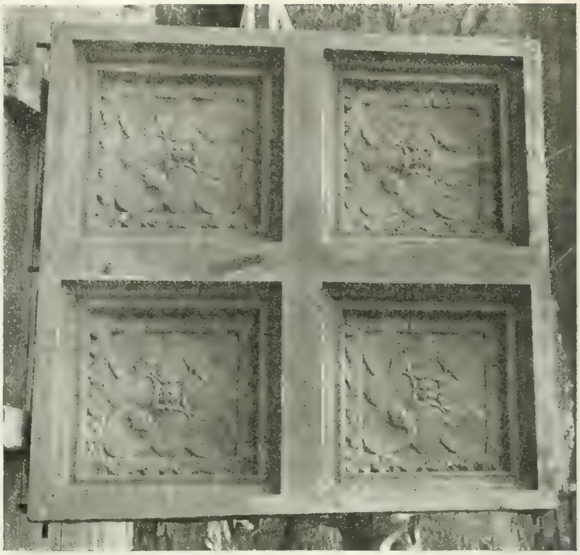

Fig. 9—The Reinforced Concrete Slab Cast in the Experiment Shown in Figs. 7 and 8

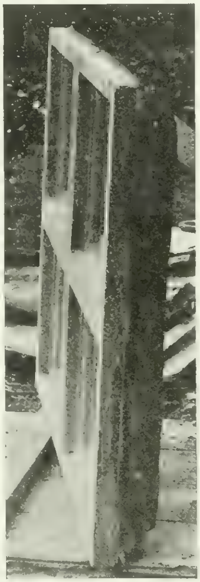

Fig. 10—An End View of the Experimental Concrete Slab

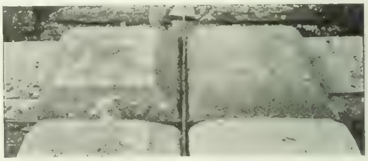

Fig. 13—Placing Concrete Over the Pre-Cast Permanent Paneled Form

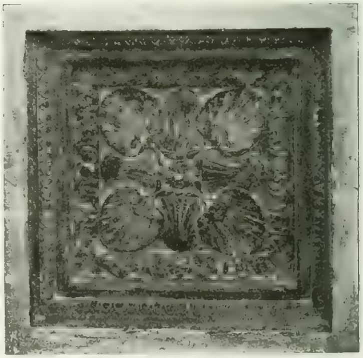

Fig. 15—The Model Plaster Panel Reinforced With Cloth in Which the Sand Molds Are Made

gates, marble, limestone, granite or quartz, some new scheme for the insertion of glass mosiac, tile or metal, some new ornamentation with pre-cast ornaments, such as rosettes, for instance. There is in use a clever method for the enrichment of concrete surfaces by blowing onto a dampened surface a mixture of cement and color which literally cements itself to the slab. A thin film of richer material may be applied over the sand molds and left to harden a little before the commoner materials of the bulk of the slab are added.

The sand mold method came about by a process of elimination. Several molding materials were tried and abandoned in succession, plaster, cement, clay, clay and sand, before sand alone was settled on as the best. It may be interesting to follow the steps of the experiments until they lead us to the completed sand-molded slab.

It was at the architectural concrete men's shops that the experiments were begun. I knew that they used plaster and glue molds for casting concrete to the exclusion of sand, because of the bulk of the latter.[3] From a full-sized detail was made a negative (Fig. 4), of the coffer. This served as a form for the glue which was poured over it to make the glue mold which was to be

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[3] Cf. the article on architectural stone, p. 61, Feb., 1913, issue

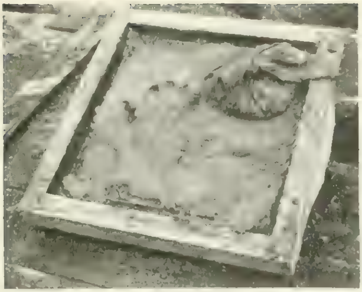

Fig. 16—Showing the Method of Filling the Matrix With Molding Sand Using the [illegible] Tamper

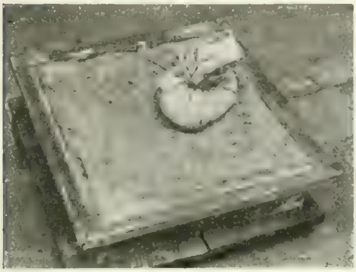

Fig. 17—The Wooden Matrix Filled With Sand

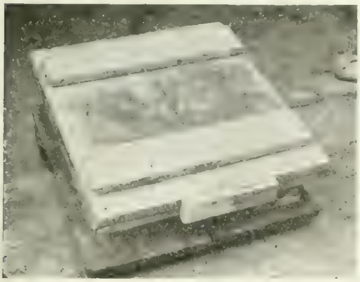

Fig. 18—The Sand Mold Covered With a Wooden Pallet Ready to be Overturned

the matrix for all the plaster forms. Figs. 6 and 7 show this glue mold and above it a plaster impression taken from it. Fig. 5 shows the front of the mold and Fig. 6 the back of it, which fits into the plaster stiffener shown at the bottom of each cut. Fig. 7 and 8 show these plaster forms in place on the forms. Fig. 7 shows the reinforcement in place and Fig. 8 shows how the concrete is to be poured. It may be remarked in passing that the reverse of this process, that is permanent coffered plaster or concrete forms, has been used to good advantage.[4] Figs. 9 and 10 show the concrete slab after the plaster forms had been removed. The result is sharp-cut and perfect, but the means is not the most economical. The plaster forms are apt to stick and are hard to get out whole. The glue mold is not long-lived and the whole process is too elaborate. Figs. 11, 12 and 13 show the

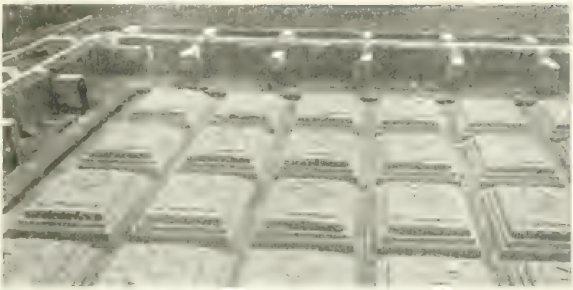

Fig. 19—The Sand Molds in Position on Floor Ready for the Steel and Concrete

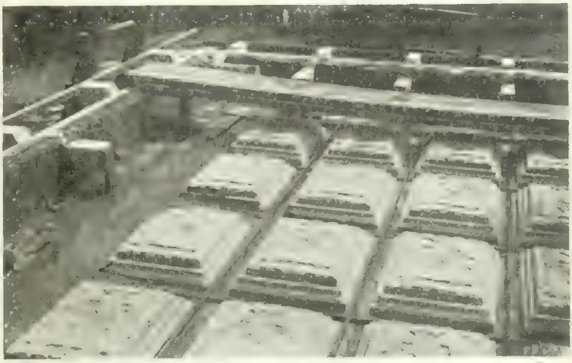

Fig. 20—The Reinforcing Steel in Place for the Sand Mold Panel Floor. A Workman is Shown in the Background

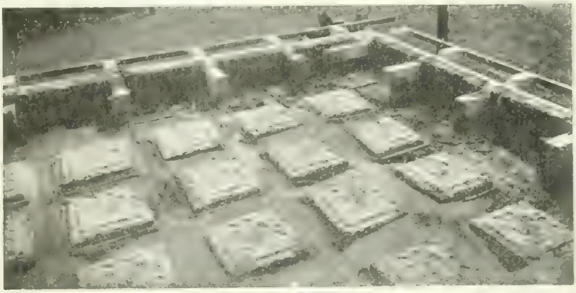

Fig. 21—The Sand Molds in Place on Floor With Concrete. A Very Wet Concrete is Used

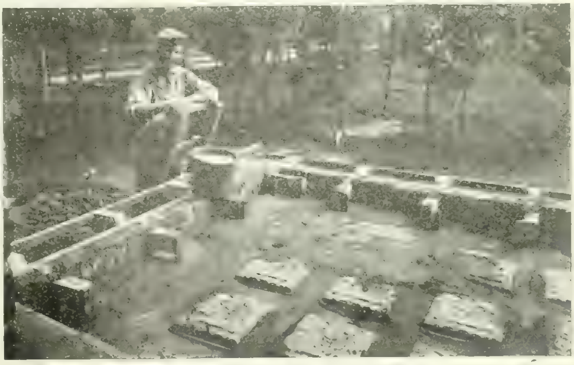

Fig. 22—The Floor About Completed

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[4] A method of using decorated pre-cast concrete panels was described in *Cement Age*, p. 174, Oct., 1911.

pre-cast panel method adaptable either to plaster or to cement. In either case the forms are apt to be fragile and there is too much cleaning and patching necessary after the forms are removed. It took me weeks to try out and abandon this method in search of better schemes. There is the decided advantage in this scheme of an opportunity of treating each form with brush, acid or immersion in a coloring solution; it is, however, none too practical. A mechanical bond with the poured concrete is required as the bond of ahesion is unreliable.

Clay molding was the next step, closely followed by the mixture of clay and sand. The clay itself had to be protected from the softening influence of the wet concrete; clay and sand needed less protection and the elimination of the clay eliminated the necessity of the covering. This brings us to sand molding pure and simple.

In developing this I was aided by the molders in the iron foundries. Sand molding depends on the physical quality that very fine sand will pack. Beaches of sea-sand pack so hard that they will stand the terrible strain of racing automobiles with little injury to the smoothness of the surface. The forms we made were rammed so hard that when struck they would ring like wood. Figs. 14 and 15 show wood and plaster molds used to give form to the sand. The process is as simple as falling off a log A skeleton centering for the floor itself is erected and the molder is provided with pallets the exact size of his mold, the matrix itself, molding sand, and a sand-bag for a rammer. A molder around New York gets $3.75 per day, which is not an expensive matter. He dampens the sand, piles it into the mold with a scoop held in one hand and rams it with the sand-bag held in the other. When the mold is full he straight-edges it with the pallet, places the palett over the mold and over-turns both on the 2 x 4's on which he has rested the matrix. Figs. 14 and 15 show the matrices, Figs. 16 and 17 shows them partly sand filled and Fig. 18 shows the pallet in place. This pallet is set on the centering and the form removed. Fig. 19 shows the piles of sand in place. Note how true the beams are. Experience showed that the ornament should have been more coarsely cut, but we have to walk before we can run, and this experience was valuable for future trials. In Fig. 20 the reinforcement is in place, and concreting started and well advanced in Fig. 21. In Fig. 22 it has floated up over part of the molds. There is here shown the kind of labor that does this work, just the ordinary two-dollar-a-day type. None of the forms was mutilated and this is remarkable when one remembers that everybody on the job was new to the game. The result was successful.

In Fig. 23 are illustrated coffers from the wooden matrix and in Fig. 24 from the more elaborate plaster. Modeling in sand is most alluring, as it is simple bas-relief and perfectly adapted to the molding material. One feels that he could spend a very delightful day modeling the ornament in place on the forms. There is a wide field for original design, as a modification along the line of good precedent, and is just as sure to be structurally correct. Sand-molding of ceilings should enjoy a prosperous and interesting future.

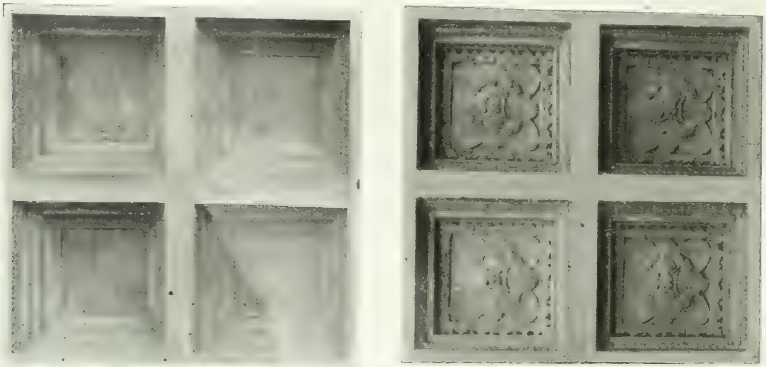

Fig. 23—Typical Panels from Concrete Ceilings Cast Over Wooden and Plaster Matrices

The N. A. C. U. 1914 Convention

The Tenth Annual Convention of the National Association of Cement Users will be held at Chicago, Feb. 16-20, 1914. An announcement as to details of this convention concerning program, headquarters, etc., will be made from time to time. Plans are being formulated for recognizing in some suitable manner the tenth anniversary of the Association.

Double Walls and Tile Columns in Residence Construction

In the Mar., 1913, issue the structural details of fireproof residence construction at Kew Gardens, L. I., were described. In this system, the first operation after the completion of the footing is to erect wall columns at convenient spacings, with terra cotta tile, placed end on with part of the cells filled with concrete reinforced with steel. Between these columns a double concrete wall is built, using a mold which forms a single course at a time and which is suspended from a rider placed across the tops of the columns. The system used, which is patented, was developed by Gurden S. Mumford, a New York architect, and both in method of operation and in the finished product represents a number of new ideas. A residence constructed by this system may be classed as a semi-poured house, as certain members, viz., columns of bonded building tile, are built in advance of pouring and used as an aid in construction by permitting the house to be built in panels (one section in advance of the other) if desirable, and also affording a method of building any small and irregular addi-

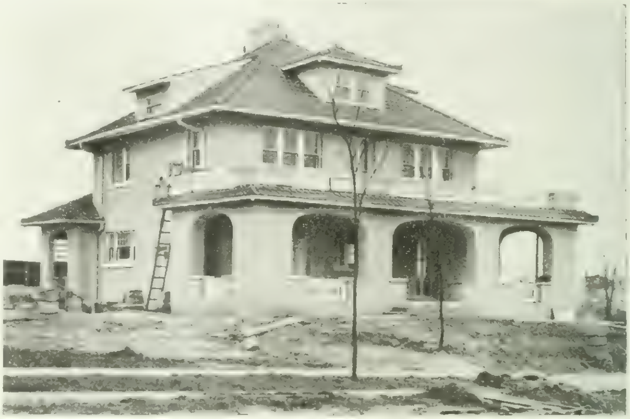

Fig. 1—General View of Residence at Kew Gardens, L. I., Built with Pre-Cast Tile Columns and Double Concrete Walls

tions of terra cotta tile and bonding them securely to the main rectangle of the house. These have a final function also of stiffening the hollow walls, and in connection with double belts of reinforced concrete wall girders, afford a rigid frame in the wall itself, all cased in and concealed. The wall appears finally as a simple, smooth wall, apparently 12" thick.

The general idea of this method is to obtain absolute security from leakage and dampness of any kind, afforded by the double concrete wall with its insulating air space, and to avoid on the other hand, the structural difficulties of distributing the floor and other weights equally on both walls; which, hitherto, has resulted in a considerable excess of material being used, and has largely acted against the use of this type for buildings of any height and size.

Other interesting features are immunity from contraction cracks and the fireproof possibilities of the new construction. Cinder concrete may be used for the inside wall and girders, the weights being transmitted to the outer girder belt which is of stone or gravel aggregate. As the bearing columns are of bonded hollow tile blocks (a refractory material) filled with cement mortar and stiffening steel rods, and are thoroughly cased in, it is hardly possible that the heat of a conflagration could do much more than crack the interior panels, leaving the wall structurally intact.

A concrete double wall in general has unusual thermal qualities, arising from the fact that concrete responds very slowly to a change in temperature.

If the belt of confined air between the walls is restricted as to circulation and connecting ties are few and poor conductors of heat, the inside wall will remain at a practically constant temperature the year around. This is a very favorable factor in dwellings as its tendency is to equalize heating conditions, an excess of heat being slowly absorbed, and as equally slowly given off when there is a deficiency.

The special apparatus used provides automatically against any damage to the green wall and eliminates the necessity for replumbing and aligning at each shift. These features, in connection with a mix of medium consistency, permits a very rapid operation, as high as 6' being cast in a day. This progress was facilitated by the fact that the double walls above and below the reinforced girders did not carry any loading, and only moderate strength was required of them. The girder members were made of a rich, very wet mixture and allowed ample time to harden before shifting the forms. In this manner the building was poured with great rapidity and economy.

On completion, the outside walls were covered with a coat of stipple-dash stucco, and plaster applied directly to the interior wall.

In the construction of this house, provision was made for completely sealing the air space of the double wall around the windows and doors, with concrete and tile block. The building

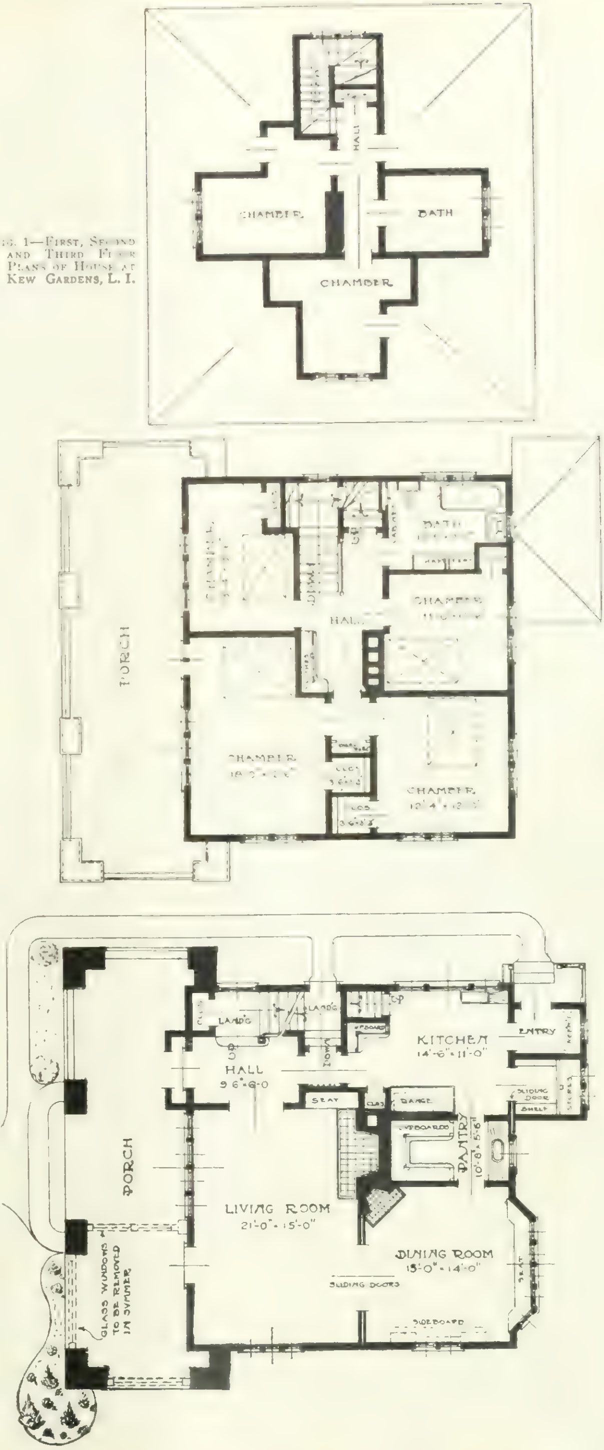

FIG. 1—FIRST, SECOND AND THIRD FLOOR PLANS OF HOUSE AT KEW GARDENS, L. I.

proved to be extremely warm and retentive of heat in the winter. The floor plans and street view of the building are illustrated in the accompanying cuts. While it is difficult to distribute the costs of a building accurately among its component parts, and to determine the exact extent to which any special form of construction affects the cost, it may be said that this type of concrete house runs somewhat cheaper than hollow tile.

Specifications for Concrete Floor Surface Course

The following quotation from the specifications cover in detail the surface course used on the concrete floors in the American Hide & Leather Co. building, Lowell, Mass., described p. 171, Apr., 1913, issue.

Finish is to be mixed 1 cement to 2 trap rock or hard gravel screenings, which will pass through a ½-in. sieve, and from which the fine dust has been removed. This is to be thoroughly mixed in a mixing box or by machine mixer, with an amount of water to produce a plastic but not a sloppy consistency; spread on the under-concrete before either the finish or the under-concrete has had time to set. It is then to be floated with a wooden float to a true level and then slightly trowled with a steel trowel as soon as possible to bring it to proper level and to smooth the top slightly. This will give a finish which is pebbly. It will not be dead smooth or slick like a sand finish.

After the finish has been troweled and has set sufficiently so that a covering will not mar the surface, it should be covered with sawdust, sand, cloths, or any other material which will hold water on it continuously. In building reinforced concrete, difficulty will be caused by sand and sawdust blowing about the work, filling the forms, and generally getting in the way. In working around a textile mill there is usually plenty of old bagging and in a paper mill there are usually plenty of old felts which can be borrowed for the purpose of preventing this.

The finish should be kept soaking wet for at least a week, or better for 10 days. After two days it is possible to put on studs and do miscellaneous work on top of the new finish, provided it is not allowed to dry out.

A New Water Power Development

At Dundee Falls, Me., a power station for the S. D. Warren Co., paper manu-ster Engrg. Corp., Boston. The dam facturer, is being erected under the general supervision of the Stone & Web-the center. The head to be utilized is 50′, with a wheel capacity of 4,500 h. p. The concrete spillway is of the gravity suction type.

Power will be supplied by three 33-in. horizontal turbines, each capable of developing 1,500 h. p. at 277 r. p. m. They are of the wicket gate type, the gates of each wheel being controlled by a Lombard governor. Each wheel is direct-connected to an 800-k. w. General Electric Co's.[1] generator of 11,000 volts. In each case the exciter is on an extension of the generator shaft.

Four-Inch Concrete Pavement Slab Tested

Because of complaints received from many sources to the effect that the concrete base being laid on the new California state highways is not sufficiently thick to make it permanent, the highway commission decided to make a test, and this was done Jan. 22, 1913, just north of Fresno. A report of the test has been submitted by J. B. Woodson, sixth division engineer, to A. B. Fletcher, chief engineer of highway construction.

The concrete base is being laid 4″ thick, but much criticism has been directed against the highway commission, because it is claimed that this will not stand up under the traffic that it will be forced to bear. In addition to the test, attention is called to the fact that the state of New York has just let contracts for 4-in. concrete base, in portions where the traffic is many times as heavy as it is in California.

According to the report of the Fresno office on the test made Jan. 22, the concrete at that point was laid Dec. 19, and was therefore 35 days old when tested. On examining a piece of fractured pavement it was still moist for the full thickness, as the weather at this time of the year is not conducive to rapid drying. The concrete would therefore probably have stood a greater strain if thoroughly dry.

A trench 2′ wide and 4′ long was dug underneath the pavement 12″ from the edge, leaving the concrete over this trench without any support.

The rear wheel of a 10-ton road roller was then run over this concrete slab in many positions.

When the wheel was run over the pavement 12″ from the edge there was no effect on the concrete. When it was run over the pavement 6″ from the edge, there was still no effect.

On the third test, the wheel was run over the concrete 6″ from the edge and stopped in the center of that portion of the concrete directly over the trench, also without any effect.

When the edge of this wheel was run over the span, flush with the edge of the pavement, there was a slight spring.

The fifth test consisted of running the wheel flush with the edge of the pavement but also over a block of wood 2″ thick, 4″ wide and 8″ long placed 12″ from the edge. There was a very noticeable spring as the wheel passed, but no fracture of the pavement.

The test that finally fractured the concrete consisted of running the wheel over the span flush with the pavement and over the block that was placed on the span, 6″ from the edge. The concrete failed to hold on this test.

Notwithstanding the fact that the concrete was still moist, the local division office reported that the results seemed to be all that could be desired as the concentration on the 4-in. block was almost 3½ tons, or about two-thirds of a ton to the sq. in., on the unsupported base.

The local division engineer made the following conclusions as to the durability of the road, in his report:

"In view of the fact that the concrete did not fracture when tested 12″ from the unsupported edge with the above concentrated load, and will never be called upon to bear such a load under actual traffic conditions, I believe we are justified in stating that the 4-in. concrete base properly constructed as the above, will stand any reasonable loads."—*Architect and Engineer of California.*

Cement Mortar in Hearth and Boshes of Blast Furnace

In the first issue of the monthly *Bulletin of the Amer. Iron and Steel Inst.* Samuel H. Chauvenet[1] describes the use of cement mortar to line blast furnaces. The salamanders in the bottom of two old furnaces (No. 1 built in 1862, and No. 2 built in 1872) are so deep and run so far under the old brick and stone casings that it was impossible to take them out without disturbing the whole support of the furnaces. It was therefore necessary to use the salamander as the hearth bottom and also to lay the brickwork of the hearth wall on it. This made such a rough, thick joint that when laid with fire-clay there was trouble from break-outs of iron. It occurred to Mr. Chauvenet that, as cement was made under such high temperature, it would stand the hot iron as well as fire-clay, or even better. The first course, therefore, was laid in pure cement mortar, some of the joints being 3″ thick. There were no break-outs on these joints, although holding as much as 50 and 60 tons of iron in the 10-ft. diameter of the hearth.

In the last relining of No. 2 furnace the foundation for the crucible wall was so rough that the brick could not be cut to fit it without very heavy joints of cement. A 1:3:5 concrete was therefore used, ground firebrick for the sand, and firebrick crushed to ¼-in. and ½-in. ring for the aggregate. This was rammed in, for the bottom of the crucible wall, for 1′ in height, which gave a smooth, even surface on which to start the brickwork. The first 2′ of brickwork above the concrete was also laid in cement mortar and on the outside of the crucible wall cement was used all the way up to the tuyeres. The salamander in the center of the crucible was 18″ above the hearth line. This furnace has been in blast for seven months and the concrete base still holds.

The Berkshire Iron Wks. has been using cement in this way for the past 12 years and no break-outs have occurred.

Albert Broden of the Reading Iron Co. was so much impressed with the use of cement at Sheridan that when an explosion in the Keystone furnace blew the lining out of the gas flues to the first elbow, he relined both flues with concrete made with cement and blast furnace slag. This Mr. Chauvenet states has stood perfectly.

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[1] Schenectady, N. Y.

[1] Mgr. Berkshire Iron Wks., Sheridan, Pa.

Concrete Road Construction Near Milwaukee

BY H. J. KUELLING, C. E.[†]

While individual cases of concrete pavements are not new, yet the fairly extensive use of concrete as a wearing surface for streets has been inaugurated within quite recent years.

Its more extensive use was brought about by a demand for a pavement to withstand auto traffic, one that would not cost so much as brick or block pavement.

While concrete as a surface is still far from free of disadvantages, I believe its use to be a step in the proper direction. I do not believe that it is the proper pavement for heavy traffic in our cities, but I do believe that it is an economical pavement for heavy country traffic, for residential streets in any city and for the main streets in the smaller cities. I believe that the larger the percentage of motor traffic becomes, the more economical the concrete street will become, because the horse and the iron tires are more destructive to it than are automobiles, a condition just opposite to that of macadam.

The selection of concrete as a paving material in Milwaukee county (Wis.) was made for several reasons, among them being the following qualities:

1. Durability.
2. Low maintenance cost.
3. Cheapness and availability of materials.
4. Simplicity of construction.
5. Low initial cost.

These all resolve into a matter of economy, which, when combined with the ease of traction, smoothness, non-slipperiness, cleanliness and sanitary qualities, make concrete as nearly an ideal pavement for rural highways as could be devised for Milwaukee county.

This type of road has some disadvantages as have all other kinds of pavements, some of which are noisiness, non-resiliency, glare in sunlight, difficulty of repair and likelihood of development of cracks. However, the noise of a concrete pavement is not particularly objectionable in rural districts owing to the fact that dwellings are more or less widely separated and furthermore are usually set back some distance from the highway.

The question of non-resiliency can be taken care of by treating the surface with a bitumen if desired but we have yet to hear a complaint that the pavement injures horses' hoofs. The glare of the pavement can be reduced or even eliminated by adding a dark material such as lamp-black to the concrete while mixing.

The difficulty of repair of concrete is not so serious a question as formerly, since improved methods are being introduced, creating the possibility of repairs which are practically as good as the original pavement. The matter of development of cracks is really only an apparent disadvantage and unless the two parts of the pavement which have become separated tend to shear past each other, making a sudden rise in the road, the crack will be harmless, except possibly to the looks of the pavement. Cracks can be easily repaired by pouring in a little bitumen and afterward sprinkling with sand, a filler which will wear for years.

Construction—In the construction of a concrete road or pavement practically the same principles enter into consideration as in any other pavement.

The manner of construction of concrete roads as carried on by the various contractors was essentially uniform, although different details were handled in different ways. The grading was done in accordance with plans furnished by the Highway department, the grades being given by the inspector in charge of the work. Standard cross-sections were adopted and the sub-grade was prepared for the concrete to conform with these. The grading in some cases was completed ahead of the concrete crew for the whole length of the road being improved, and in others for a short distance only, depending to a large extent upon the amount of earth to be moved. In our work a large proportion of the grading consists merely in cutting off the usually excessive crown of the old road and placing it on the sides to widen the sub-grade and form shoulders at the sides of the pavement.

After the sub-grade has been brought to shape the forms are set up at the sides, at a distance equal to the width of the finished pavement. These are of planks 2"x6" or 2"x7" set up on edge, supported by stakes driven at frequent intervals. The 1912 work was done using the 7-in. depth in some cases and 6-in. in others, the former in the event of a crowned sub-grade and the latter where a flat sub-grade was employed. In this connection, the practice of using a flat sub-grade is considered better by this department and will be used in next season's work, owing partly to the fact that the crown is obtained by thickening the central portion, thus strengthening the part where the greatest strain is encountered, and partly for drainage and construction reasons.

Drainage—A concrete road or pavement requires good drainage as well as any other form of road construction. As a rule, more attention is given to this point in cities than in rural districts, due, perhaps, to the fact that a larger share of the work is planned and supervised by engineers. In some respects, for several reasons, it is a more important point on country highways than on city streets. Streets generally have some form of gutter which permits the water to flow off quickly, while country roads must depend entirely upon the side ditches. Streets as a rule are wider than country roads, thus being in less danger of the foundation becoming saturated, a condition which will surely cause heaving by frost.

Besides attention to surface water, the engineer must be on the watch for underground water, and have tile inserted where necessary. Tile are called for not only in low flat districts, but very often in a rolling country or where a road runs along the side of a hill.

Foundation—If the drainage is thus properly looked after, the matter of a correct sub-grade is quite simple. Where considerable grading is done and a tractor of some kind is used, sufficient compacting of the foundation may be done during the grading to make it firm. This condition is more likely to arise in country road construction than in city work, as in the latter case the foundation is more likely to be nearer grade. Where a concrete pavement is to be constructed on a street that was formerly covered with macadam or gravel, I believe that where possible, the old street material should be used as a foundation for the concrete as it adds firmness as well as assisting very materially in the drainage.

Materials—The materials that enter into the concrete should be well considered because the work to be done by a concrete pavement is entirely different from that done by a concrete foundation.

First of all a good quality of Portland cement should be used; of this there are numerous brands now upon the market. Next the aggregate should comply with a good standard of cleanliness, size and hardness; the better the standard, the better the concrete that will result. One practice especially I would like to advise against, and that is the use of bank-run gravel, even where attempts are made to determine the proportion of sand and stone in it and also the percentage of voids. Even though careful efforts are made to bring the gravel to a proper grading by the addition of stone, one will meet with failures because practically no pit is uniform in character, and the lack of uniformity necessitates a continual change in mixture. Such changing is well known to be a bad thing for the crew as well as for the resulting concrete. The only alternative is to screen all the gravel, and re-mix the sand and stone in the mixer. In nearly every case the gravel will be found to contain an excess of sand of which some disposal must be made or stone purchased to add to it.

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[*] Read before a recent meeting of Farmers' Institute of the state of Wisconsin

[†] Highway Commissioner, Milwaukee County, Wis.

Where gravel is purchased without screening, it must be remembered that a cu. yd. contains considerably more material than is the case where it has been screened. This is almost as important a point to consider in arriving at the proper change in price as is the added cost of screening. In a general way I believe that a clean, screened gravel is better than a mixture of sand and crushed limestone. The harder the stone contained in the concrete, the better will be the wearing qualities, as the stone must carry the wear rather than the mortar, thus making crushed granite or hard gravel an aggregate more valuable than crushed limestone, especially the softer varieties.

Mixture—A proper mixture, I believe to be about 1:2:4. However, we should not adopt the mixture blindly, but make a careful study of the voids in the sand and the stone that are available for each job, as some materials require more cement than others, to obtain an equally good concrete. Because of this fact, it is sometimes economy to pay more for sand with a low percentage of voids than to use what seems cheaper at first sight.

Water—it is needless to say that plenty of fresh, clean water should be available at all times. This is generally a simple enough problem in cities but an entirely different one in country road work. Last season we used 12 miles of 2-in. pipe. In some cases we had pressure enough from city hydrants, while in others we were compelled to put a booster pump in the line.

Mixing and Laying—Even if proper drainage, foundation and materials are obtained, failure may result unless care is taken in the construction of the street.

First of all, some good form of batch mixer should be used, as a failure properly to proportion in a continuous machine means a hole in the pavement. Personally in my country road work, I prefer a machine with a spout discharge rather than either the boom bucket or carts, because I believe the material to be more evenly placed upon the street; because there is not the tendency to disturb the foundation and mix dirt with the concrete, that there is with carts, especially on narrow roads; and because the spout causes less trouble in placing the expansion joints. Some will argue that more material can be placed with carts because of the larger and easier source of supply in the piles, but I believe that with a little care in placing the sand and stone an equal amount can be placed, especially with the large tractor mixers now on the market.

A good practice in mixing concrete, as well as any other work, is to keep the same man doing the same class of work around the mixer, so that it becomes almost second nature for him to do the right thing at the right time.

The following, I believe, is a fair arrangement for a crew, especially on road work.

1 foreman.

1 man to attend to preparing joints.

3 men to attend to sub-grade, so that material can be dumped and concrete placed.

2 form-setters.

6 men who load wheelbarrows.

4 men who handle wheelbarrows.

2 men for handling cement, one who delivers it and one who dumps it into the hopper.

1 engineman on the mixer.

1 man at the hoist.

1 man who handles the spout for placing the concrete on the road.

2 men for striking off the concrete with a strike board cut to the crown of the road.

1 man for finishing the concrete and trimming the edges.

1 general utility man.

This gives a total of 26 men whose daily pay would aggregate about $63. Such a crew should average about 600 sq. yds. of 7-in. concrete per 10-hr. day.

As to the relative merits of the one- and two-course types of pavements, I prefer the one-course type, mainly for construction reasons, although there are many arguments for both sides.

Where it is necessary to place reinforcement, which I believe is not often, it is more difficult to get it placed near the surface in the single-coat work than it is in the two-coat work. A cheap and satisfactory form of reinforcement is common woven fence wire.

After the concrete is properly placed, it should be well cured. In our work we cover the road with earth or gravel as soon as it is hard enough to carry it. For the first five days it is kept well sprinkled, especially in warm weather. The roads are kept free from traffic for 20 days in order to give the concrete sufficient time for complete setting, and contractors are required to maintain strict observance of this clause of the specifications. In spite of the fact that it is common knowledge that concrete requires a number of days to harden before being fit to bear traffic, it was found necessary in several instances to employ members of the sheriff's force to emphasize the fact. It is to be hoped that some time in the near future it will be realized that in order to gain any improvement, some temporary sacrifices must be made. Notwithstanding the carefulness of the watchmen, barriers were deliberately removed by travelers and some damage was done, the most glaring example being on the Janesville plank road, where a team and wagon drove over the green concrete leaving a shallow rut about 600 ft. in length. While this may not appear serious other than on the surface, the whole pavement is injured in the vicinity of the depression, due to the disturbance of the particles at the time of the final setting and the consequent destruction of the bond.

Joints—One of the most important problems in the construction of a concrete road or pavement is the matter of proper joints to provide for expansion and contraction. Many types are in use, such as a plain filled joint, wood joints, felt joints and steel combined with some of the others, the steel acting as a protection to the joint, and sometimes as a reinforcement across the end of the slab. In Milwaukee county we have used a rather high-priced joint consisting of two pieces of asphaltic felt between two pieces of steel. The felt reaches entirely through the slab while the steel is 2½" deep only and is anchored into the slabs by 6" wings punched into the steel[1] After a little practice this joint is easily erected, costing in place, about 5c. to 6c. per sq. yd. of pavement. These joints are placed at 25-ft. intervals. Engineers differ as to the proper spacing of joints, judgment varying from 20' to 50' and even 100', while a few are trying out roads without any provision for expansion. This I believe to be a very bad practice. I believe that the further apart the joints are placed, the wider should be the joint, and the wider the joint is, the more danger there is of a defect developing in the road. The common practice is to place these joints at right angles with the line of travel, but I believe that a slightly better practice that is being introduced, is to place them at an angle so that two wheels do not come to the joint at the same time.

Surfacing—As to whether or not a bituminous treatment on a concrete road is economical in all cases, I am unable to say. For certain conditions, however, I believe that it is well worthy of consideration for several reasons. It acts as a cushion to traffic, thus making it easier for horses' hoofs as well as protecting the concrete itself from grinding away. It tends to relieve the glare of the street, and deaden the noise of traffic, thus making the pavement more desirable for residential streets A fair treatment is about ½ gal. of bituminous compound per sq. yd. After pouring, the bitumen is covered with a sprinkling of coarse sand, as is done after oiling an old macadam street.

Such a treatment under a fair traffic would last one or two seasons; the center of the street for one, and the sides for two seasons. Such a treatment would cost about 1c. per sq. yd. for application and not over 5c. for the material. There are several treatments of this kind with patents pending, but I do not believe it necessary to use any of them, because bitumen of the proper mixture can be purchased that will be satisfactory.[2]

While being treated, the street should be thoroughly clean and thoroughly dry or the material will peel off under traffic.

As regards the cost of concrete roads or pavements, the conditions vary so greatly in different parts of our state that what would be proper for our Milwaukee county work would be entirely wrong in some other sections. Because of the varying cost of sand, stone, men and teams, I can make no definite estimate of a sq. yd. price, but in a general way will state that the pavements have cost us on an average, in the neighborhood of $1.00 per sq. yd., exclusive of grading. This is divided into about the following proportions for the various items:

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[1] R. D. Baker Co., Detroit

[2] While this may be true, there are undeniable advantages in being able to secure an absolutely standardized product for this work.—Editors

Cement	$0.30
Gravel and stone	.13
Labor and hauling	.47
Joints	.06
Inspection and water	.04
Total	$1.00

These figures are based upon team hauling at $6.00 per day per team and common labor at $2.25 per day.

This cost is about 1½ times that of plain waterbound macadam under similar conditions in Milwaukee county and about 10% to 15% more than asphalt or tar macadam would cost.

The question which immediately arises is whether or not the concrete road is worth the difference. In answer I would say that we believe it is or we would not have given up all other forms of road construction in favor of concrete for our main highways in the county. With the heavy maintenance cost that we would have to meet on any form of macadam roads, in order to keep them in a decent condition under the heavy traffic of our county. I figure that in a comparatively short period of years we would be justified, from an economic standpoint, in tearing up our concrete road and placing an entirely new one. However, I do not believe that such an extreme method will be necessary for many years on a well constructed concrete road.

Even under medium country traffic, I think that there are many places in Wisconsin with a plentiful supply of good gravel which would be more than justified in placing concrete upon their highways. It should be remembered in this connection that the initial cost in road construction is by no means the only cost to be considered, and what may at first appear to be the costliest road, may and often is the cheapest road when the question of maintenance is properly considered.

In conclusion I would add that I believe concrete road construction to be in its infancy only, and that another decade will see it extending over a wide territory. I also believe that many people will make mistakes by not profiting by the knowledge of those who have had experience, for it seems that almost every community feels it its duty to carry on some kind of experiments.

The General Electric Co. has awarded the contract for the construction of Bldg. No. 43 at Pittsfield, Mass., to the Turner Construction Co., N. Y. C. The building will be 500' x 63', five stories in height and reinforced concrete throughout. M. M. Thrane is architect. Work is now under way.

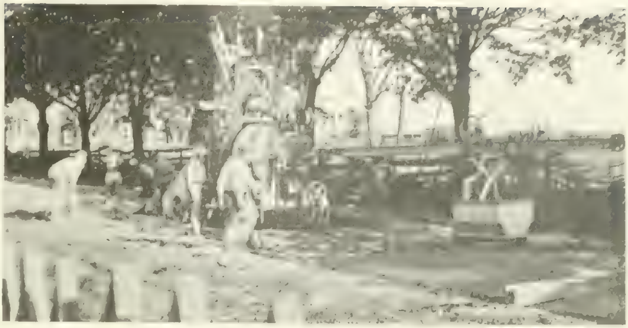
Fig. 1 [illegible]

Cost Figures on Four Concrete Roads

In the Dec., 1912, issue, a paper by A. N. Johnson, State Engineer of the Illinois Highway Commission, was published, this paper going into considerable detail as to methods of concrete highway construction. In the Mar., 1913, issue a brief article by Mr. Johnson was published describing the construction of the Carlinville, Ill., concrete road and giving some cost information. In view of these previous discussions of the methods employed in concrete road building in Illinois, the accompanying table of costs on four concrete roads, Carlinville included, will be especially interesting. The table is supplied by Mr. Johnson.

In connection with the construction of concrete roads by the Illinois Highway commission an interesting type of template has been developed. This is shown in Fig. 1, from a photograph of work on the Carlinville road. This template is intended particularly for use on wide roads, where a single plank is

Table of Costs of Concrete Roads

Road	McLean	De Kalb	Springfield	Carlinville
Amount of pavement laid	5000 sq. yd.	7334 sq. yd.	5594 sq. yd.	7111 sq. yd.
Thickness of pavement	6 inches	6½ inches	7 inches	6½ inches
Width of pavement	45 ft.	12 ft.	18 ft.	16 ft.
Length of haul for materials	[illegible] mile	½ mile	[illegible] mile	Sand 1½ mile Stone ½ mile
Cost of cement per bbl.	$1.02-$1.06	55 cents	$1.02½	98 cents
Cement used per sq. yd. of pavement	.29 bbl.	.31 bbl.	.29 bbl.	.33 bbl.
Cost of Labor and Supplies				
Superintendence	[illegible]	$ 200.00	[illegible]	[illegible]
Excavation		900.02		591.73
Shaping road bed	[illegible]	69.75	[illegible]	108.70
Trimming shoulders and side road		72.60	211.38	. . .
Loading and hauling sand and stone, including rehandling	267.34	596.02	603.50	795.05
Mixing and placing concrete	[illegible]	746.65	644.25	700.58
Watchman and miscellaneous labor	110.26	187.07	383.75	131.46
Cost of sand and stone f. o. b.	1,017.63	1,671.00	1,622.01	741.00
Cost of cement, f. o. b.	1,547.15	1,250.00	1,551.17	2,307.90
Expansion joints	[illegible]	160.13	206.74	112.40
Reinforcing steel	. .	. . . .	. . . . .	100.00
Coal and oil for mixer and miscellaneous supplies	[illegible]	[illegible]	119.19	25.00
Forms and other lumber	35.00	119.77	18.33	31.75
Filling expansion joints next curb	45.18		. .	.
Car fares for men		51.16	. .	
Pay for time of men coming and going		136.25		
Total	$3,964.02	$6,194.42	$5,794.76	$5,803.07
Cost Per Square Yard for Labor and Supplies				
Superintendence	[illegible]	$0.0273	$0.0361	$0.0229
Excavation		0.1227	.	0.0840
Shaping road bed	[illegible]	0.0095	0.0415	0.0153
Trimming shoulders and side roads		0.0099	0.0378	. . .
Loading and hauling stone and sand, including rehandling	0.053	0.0812	0.1078	0.1120
Mixing and placing concrete	0.083	0.1020	[illegible]	0.0986
Watchman and miscellaneous labor	0.022	0.0255	[illegible]	0.0184
Cost of sand and stone f. o. b.	0.204	0.2280	0.2897	0.1050
Cost of cement f. o. b.	[illegible]	0.1700	0.2772	0.3246
Expansion joints	0.010	0.0218	0.0369	0.0156
Reinforcing steel	. . . .	. . . .	. . . .	0.0140
Coal and oil for mixer and miscellaneous supplies	0.006	0.0044	0.0213	0.0034
Forms and other lumber	0.007	0.0163	0.0033	0.0047
Filling expansion joints next curb	0.010	. . . .	.	.
Total	[illegible]	[illegible]	[illegible]	[illegible]

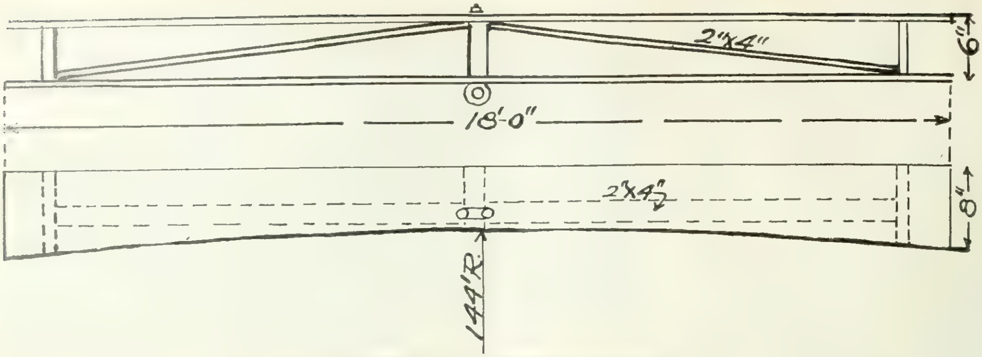

Fig. 2—Detail Sketch of Double Plank Template

not stiff enough, and where the concrete to be struck off covers so great a width as to make it practically impossible for two men, one at either end, to move the template. Thus the idea of a double template with a rope attached in the center by which to pull it. Mr Johnson writes of this template as follows:

"The template we use was constructed by one of the men in the field and I am enclosing herewith a rough sketch. (Fig. 2.)

"We find that on a 16-ft. road it is necessary to have a hook at the middle of the template to pull it by, as the two men at the ends cannot push it against the concrete which is being spread. This necessitates having a template which will be pretty stiff and we accomplish it by using two planks which are braced by means of struts.

"In addition, the template has two points of bearing about 8" or 1' apart on the side forms, and can easily be kept in a vertical position. I do not know that there is any particular advantage in this form of template, but we have found it to work very satisfactorily and to possess some slight advantage over a single board."

Notice at the right in Fig. 1 that the sand and stone have been so piled along the line of construction that the mixer is using up just enough so that the material is close at hand, within shoveling distance. This point was brought out in connection with Fig. 2, page 119, Mar., 1913, but Fig. 3 shown herewith is even a better view, indicating care in hauling and dumping stone and sand.

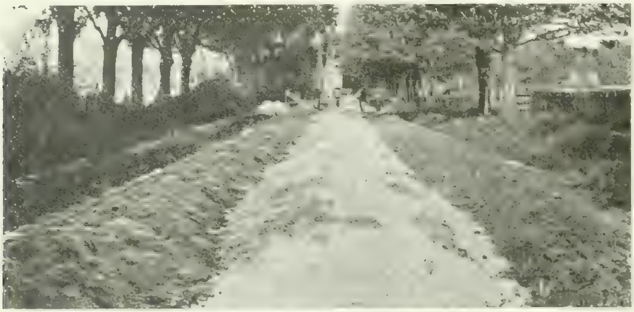

Fig. 3—Material Piles Make Long Even Lines

Suggests Improvements in New York Highways

W. Pierrepont White, Utica, N. Y., one of Governor Sulzer's specially appointed advisory commission on roads, has submitted a minority report to the New York state governor, in which he makes some interesting suggestions on the State Highway Department and on the improvement of the roads themselves. In this minority report, Mr. White calls attention to the lack of continuity in the construction of important highways in New York state, and to the enormous annual highway budget, particularly to the heavy maintenance fund of $1,000 per mile. In summing up, Mr. White lists the difficulties and remedies as follows:

Difficulties—The weak points in highway development in this state are as follows:

1. Intense and excessive demand on the part of the residents of all sections of the state for instantaneous and immediate construction of roadways in front of their homes, irrespective of the character or durability of the road, or method of payment for the same.

2. Difficulties forced upon the highway department by immature and illy-considered acts of the Legislature, which have made it impossible to secure permanency of organization and a complete plan of operation.

3. Hardship now being forced upon the taxpayers by inexperienced legislation, which compels the state to issue bonds with a life of 50 years, while the highway department is building roads whose life is barely 12 to 15 years.

Remedies—1. A single-headed commission, appointed by the governor for five years, the single commissioner to have full power of appointment and removal of his deputies and his division engineers, is doubtless the most efficient character of organization to secure the results that will be satisfactory to the people.

2. Let no new contracts for the year 1913. Neither the engineering force of the highway department, nor the contractors, nor the manual labor, can be obtained properly to construct more than 700 to 800 miles of highway per season. The attempt to double the mileage by letting the contracts for the same, has resulted in superficial preliminary engineering, the permitting of construction work late in the season, under bad weather conditions, and in the entering into of supplemental agreements, some advantageous and some disadvantageous to the state.

Concrete Roads—It has been stated on good authority that roads can be built of concrete at a cost of $14,000 per mile, with a durable and inexpensive surface, which will last not only for 50, but 100 years, provided the surface is renewed at reasonable lengths of time, to wit: $200 per mile per annum for maintenance in place of $1,000 per mile that it is now costing the highway department. Should this prove to be true, the interest and sinking fund on the $100,000,000 would amount to $6,000,000 a year; and a maintenance of $200 a mile on 10,000 miles of highway would amount to $2,000,000 more, which would give us a highway expense per annum of $8,000,000, a prospective saving of $8,000,000.

Operation for 1913—The interests of the State of New York would doubtless be conserved if the following line of action could be followed for the year 1913.

1st. The enactment of legislation providing for a single-headed commission, the commissioner to be appointed for a term of five years, removable for cause by the governor, with full power of appointment and removal of the three deputies and 10 division engineers, with proper organization and compensation to the engineering department.

2nd. The highway department should be relieved for the present year of the strain of being compelled to let and construct any additional highway mileage. The single-headed commission should organize a proper engineering force, and devote the entire time for the balance of the year to the following:

1. Proper and able maintenance of the present highways which are now completed, so as to avoid any deterioration.

2. An efficient and able progression of the highway contracts now in process of completion, amounting to some $22,000,000 and covering some 1,500 miles of state and county routes.

3. The re-mapping of a proper system for the state, equitably apportioning the mileage to the counties, and uniting as far as possible the parts of the present state and county highway system which are completed or under contract, which system should not exceed a total of 12,000 miles.

4. Ably planning the work for 1914, together with the determination of a type of road which, when constructed, will certainly last for the life of the 50-year bond which is issued to pay for the same.

5. The referendum of last fall should be resubmitted to the people, in order to permit:

(*a*) An adjustment of the rate of interest to the condition to be met at the date of the sale of the bonds.

(*b*) Provide for a serial issue of the bonds, so as to have no accumulation of the sinking fund.

(*c*) Permit the state to re-map and assume the entire cost of construction and maintenance of the entire 12,000 mile system, without any contributions from the town or county as now required.

Use of Steel Power Belting Increases Abroad

A report from the American consul at Huddersfield, England, indicates that steel power belting is no longer an experiment, but a success in every way. A factory in Huddersfield, operating under the license from the German patentees, is turning out steel power belting to meet a constantly increasing demand. One of the large manufacturing plants in Huddersfield has recently adopted steel power belting for general power transmission and many other factories are planning the same change. This indicates that steel belting probably saves power and ultimate expense.

Following an item on this in the *Daily Consular and Trade Reports,* the Huddersfield office was questioned repeatedly as to what could be done to get this power belting into this country. It developed, however, that the English firm is so overwhelmed with orders that it cannot make any effort to get belts into America. The German firm is not aggressively in search of new fields and about the only way steel belting can be introduced here is to form a firm of American capitalists and take over a license for the manufacture of the belt in this country.

Further developments will be watched with interest.

New Lines in Concrete Products Field

The field of operations of the concrete products manufacturers is growing all the time. Striking proof of this is in information which comes to CONCRETE-CEMENT AGE from W. H. Filer, Grove City, Pa. Mr. Filer has made use not only of molds which are on the market for standard products, but he has also done a great deal of experimenting and devising on his own account, until he has developed a most interesting line in concrete products manufacture. Like most such enterprises, the concrete building block item is an important one in the business, but with Mr. Filer this does not, by any means, monopolize all the space or time in the factory. One Hercules[1] block machine is operated, producing about 500 building block per day. These block are 8" x 8" x 16". Three men at the machine, which is equipped with

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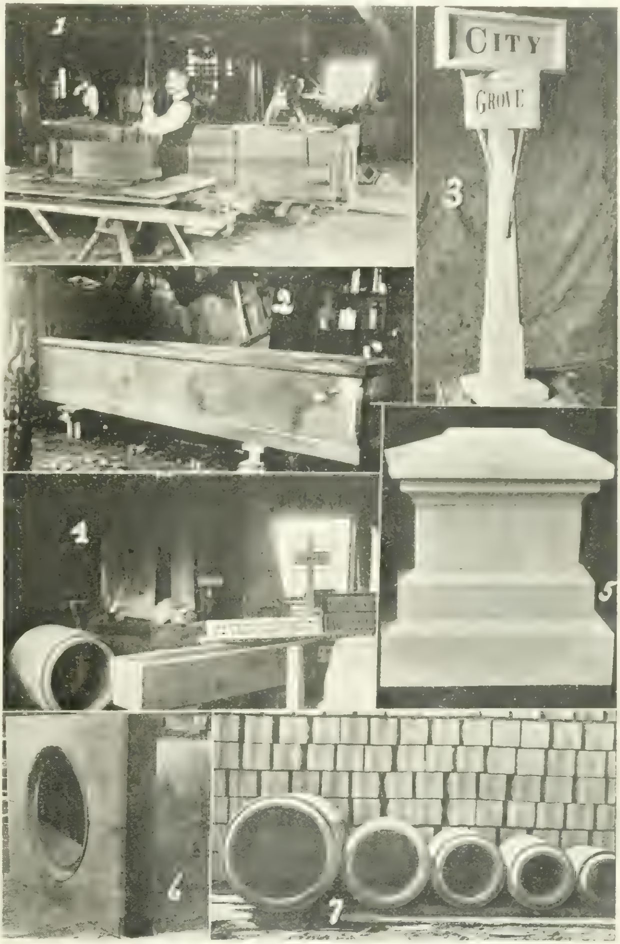
[1] Century Cement Mach. Co., Rochester, N. Y.



CONCRETE PRODUCTS MANUFACTURED BY W. H. FILER, GROVE CITY, PA.

Fig. 1—Acid Tank 12'x2'x2' being cast in wooden mold. Fig. 2—Tank removed from mold. Fig. 3—Type of sign boards and standard intended for street intersections, parks, land markers, railways and so on. Fig. 4—A group of various products including culvert pipe, grave marker, railway mile post signs, lot markers. Fig. 5—Concrete monument. Fig. 6—Culvert head in two pieces, put in place over a section of pipe. Fig. 7—Culvert pipe and concrete block

an automatic tamper, turn out the 500 block in 9 hrs. Concrete is mixed for them. The Hercules equipment is also used in making caps, sills and steps. Besides these principal items in the business, Mr. Filer also manufactures concrete vats, stock tanks, watering troughs and burial vaults. More recently he has begun the manufacture of concrete tanks, which are used to contain acid in electrotyping. In making these tanks he uses a special acid-proofing composition on the inside. This composition Mr. Filer makes and controls. A Bessemer gas engine supplies the power in the shop. Most of the special work done is in molds made in the factory.

Another one of Mr. Filer's recent developments is the use of colored lettering cast in such products as street signs, monuments, etc. Cement is used in this secret composition and just how the work is done Mr. Filer has not made public. The material used in this lettering extends into the block of concrete about 3/16" to ¼" and is dovetailed with the inner section larger than the outer, so that there is never any loosening of the letter. This development has made it possible for Mr. Filer to go into several special lines, some of which are best shown by photographs, which are reproduced herewith. These include the street signs, railroad signs showing distances to stations, monuments and also railway mile posts. The mile post is made triangular in section, 7' long, having two faces which are 10" wide, in which the letters and figures are cast in a white Portland cement background.

Mr. Filer also manufactures heavy concrete pipes from 10" to 24" in diameter and from 24" to 30" in length, all walls 3" thick, for culverts. He also casts, in two pieces, a culvert head, made in the various sizes required for the culvert pipe.

Mr. Filer has recently designed a telephone booth and watch box for railroad use, the booth being sexagonal, 2' 6" on a side and with an extreme diameter at the base of 5' 3". It is proposed to cast these in a yard and load them aboard cars for transportation to site.

The Filer factory and yard covers a space 180' x 300' and has a railroad siding. The plant is so located that all raw materials have to come in by rail. A traveling crane is operated in the shop, which makes it possible for one man to handle the heaviest work which is manufactured, including the big acid tanks, one of which is shown in one of the illustrations inside the molds and in another view, after removal from the molds.

CONCRETE-CEMENT AGE *is in need of copies of the issues of July and August, 1912. If you have copies to spare, please drop us a line. We will pay 25 cents each for them or advance subcriptions two months.*

Ornamental Concrete Lamp Posts

BY HAL G. HALL

Combining utility, beauty, durability and low cost of installation, the light standard shown in Fig. 1 seems to fill every requirement heretofore met by similar devices of wood, stone or metal. Excepting for the reinforcement and the electrical fixtures, the completed post is of concrete from 2' 6" beneath the surface of the ground to 10' above the ground. Once installed, there need be no maintenance expense whatever, excepting for the occasional replacement of globes. Even the light globes are less liable to accident in this type of lamp than in the more common variety in which the globe is open on all sides, and susceptible to injury from tree branches above as well as from small boys below. Furthermore, as great efficiency is obtainable from a small globe with a reflector above as with the larger open globes, and replacements can be made at about one fourth the cost. So much for the advantages of this type of light.

The base of the post is molded in one form and the shaft in another, the two being later cemented together, the shaft fitting into a socket in the base. The ornamentation at the top of the shaft and at the junction of the base and the shaft are added when the essential parts are completed. Finally the entire surface is coated with cement paint, consisting of cement and water, filling up all small imperfections.

If a large number of posts were to be made, it would of course be more economical to have the molds duplicated. Mr. Paige, the superintendent of Parks in Pomona, Cal., where the light standard is in use, finds that he can use the park workmen's time to best advantage on this work by having molds for two bases and four shafts in use at once. By this method, two men can mold two bases in half a day, and the same two men can then make four shafts in another half day. Thus, the concrete sets in the first set of molds by the time that they are again required for use. In the case of park work or where the men are on the job all the time, the bases and shafts may be cemented together, the trimming added to the junction of base and shaft, and to the top of the shaft, and the electrical connection done at any time that the men are available for a short time. Mr. Paige has found that all the necessary labor on these light standards can be done satisfactorily by common day labor, though in some cases it might be necessary to employ experienced masons for the cement work and electricians for the wiring, especially if the man in charge were not familiar with the work.

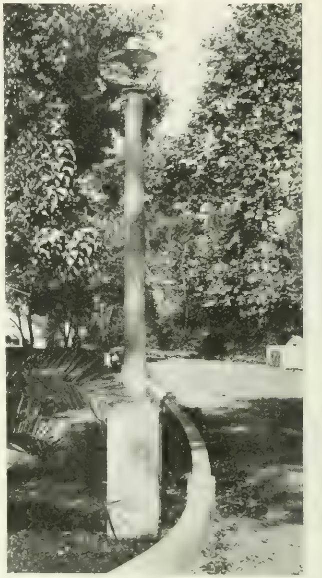


Fig. 1—Concrete Lighting Standard Costing $7 25 in Pomona, Cal.

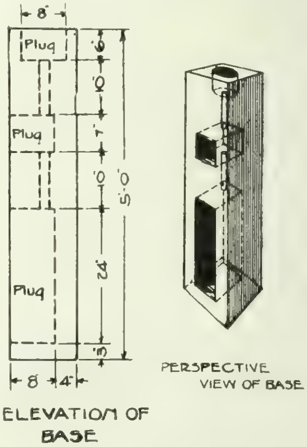


Fig. 2—Detail of Base Mold

As to the actual operations, the forms for the shaft are set up in an inverted position, and the concrete put in at the top, (the bottom of the completed shaft). The forms, which are of sheet iron, are set up at the side of a platform from which the concrete is dumped. The platform is necessary on account of the very considerable height of the forms for the shafts. A ¾-in. conduit of galvanized iron, running through the center of the post, projects 1" from the top. Consequently, the inverted forms can be set on a

1-in. board, through which the iron pipe projects while the forms are being filled. This projection on the conduit is later threaded to accommodate the lamp fixture on the completed standard. The shaft is reinforced with three ¼-in. twisted steel rods, placed near the outside of the form. The forms for the shaft are 5" in diameter at the top and 7" in diameter at the bottom. The total length of the shaft is 8′ 6". A mixture of 1:4 cement and sand is used for the shafts.

As to the base, the forms are made from plain 1-in. redwood lumber. The forms are made for a base 5′ in length, and 12" x 12". Of the 5′ of length, 2′ 6" are buried, when the post is set up. In making the forms, allowance must be made for a round plug, 8" in diameter and 6" long, at the end which will be the top of the base. This plug is removed from the form after the concrete has partly set, (about 3 hrs.) Similarly, by means of plugs in the forms, two rectangular cavities are made in one side of the base. These cavities are 8" deep, or 2" beyond the center of the base. They are both 5" in width, and the top one is 7" high, and the bottom one 24". The top one is for the fuse box and the lower one for the underground electrical connections. Through the center of the post, a 10-in. length of 2-in. iron pipe connects the round cavity in the top of the base with the fuse-box cavity, and the bottom of the fuse-box cavity is in turn connected to the top of the lower 24" opening by a 7-in. length of 2-in. pipe. A ½-in. twisted steel reinforcing rod is placed near each corner of the base. Thus, in molding the base, there are inserted three plugs (of wood) temporarily, and two lengths of pipe and four reinforcing rods permanently. When the concrete of the base has thoroughly set, a piece of 1-in. board 5"x7" is driven into the fuse-block cavity. When the wiring is installed, the fuse-board is screwed onto this block, and a small sheet of galvanized iron is finally screwed over the 5"x7" opening in the post. This iron may be readily removed, in case it is necessary to replace fuses. A 1:5 mixture of cement and gravel is used for the base.

When both base and shaft are thoroughly set, the 7-in. bottom of the shaft is set in the 8-in. hole in the top of the base, and the base and the shaft cemented together, with a ½-in. union.

The graduated ornamentation at the top of the base of the post in the illustration is added at any time with a galvanized iron mold having clamps at opposite corners. This mold and the sheet iron molds for the shafts were made by a sheet-iron cornice maker.

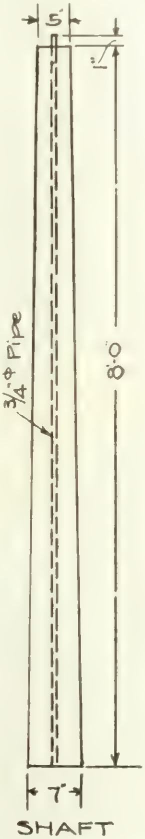


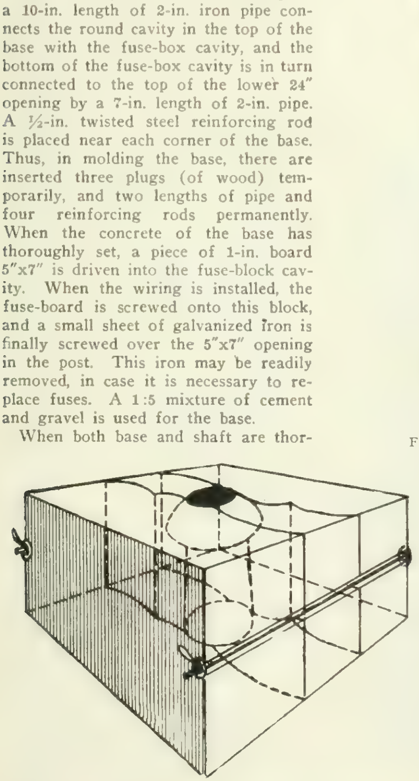
Fig. 3—Detail of Shaft

The small bead or ring around the top of the shaft is also put on at any time after the completion of the post. The form for the bead or ring at the top must be made of wood, in at least three pieces, but preferably in four, as shown in the illustration. The design of the beading is turned on the inside by a wood lathe, and the four blocks are held together by the clamps as shown in the sketch.

The wiring for the post runs from an armored cable through the bottom slot in the base of the post and up the conduit through the center of both base and shaft to the fixture at the top of the post. The fixture in the illustration consists of a curved piece of ½-in. pipe, with an elbow at either end, one screwing onto the projection of the conduit at the top of the cement shaft, and the other supporting a 14" reflector and the lamp socket. The lamp used is a 40-watt tungsten. Danger of breakage might be further minimized by the addition of a movable link between the lamp-socket and the reflector.

As to the cost of these lighting standards, they are made in Pomona, Cal., for $6.25 each, and installed at a total cost of about $7.25 each. These figures are in addition to the original cost of the forms, which cost the Pomona Park superintendent about $30. This price includes a duplicate set of base forms, four sheet iron forms for shafts, and forms for the decorations at the junction of base and shaft, and at the top of the shaft.

These light standards not only serve their purpose at night, but are a distinct ornament to a park or grounds at any time. Their decorative aspect has been the subject of hundreds of compliments from tourists visiting Pomona parks, and their serviceability has been amply demonstrated by almost two years of satisfactory use, in which time there has been practically no upkeep expense, with the exception of a few replacements of globes.



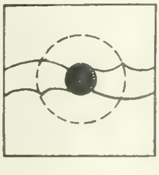


Fig. 4—Mold for Cap at Top of Shaft—Perspective at Left; Top View at Right

Artificial Marbles

A German exchange gives the following directions for making artificial marble: 1. Burnt gypsum is saturated with a solution of lime in alum water, burnt again, ground finely, or rather pulverized, adding 1/12 by weight of the gypsum of alum, and cast in the mold. These harden very slowly, but attain the hardness and transparency of marble. Different pigments may be added to obtain different colored marbles. 2. Pieces of burnt gypsum, the size of the fist, are put for 3 hrs. in a 12% solution of alum in water of a temperature of 85° to 104° F., burnt again, pulverized, adding 1/16 powdered alum, and lastly worked into molds with water containing 1/16 sal ammoniac for each part of gypsum. Castings made of this combination possess great hardness and brilliancy, and it may, therefore, be used for fine statues.

[These compounds answer very well for interior work, but the process is somewhat slow and intricate.—Editors.]

Design of "Armored Tubular" Floors

BY D. DONALDSON*

The armored tubular floor[1] system illustrates very readily the requirements of correct design principles, considering the limitations in stress now generally recognized, and the precise disposition of varying materials to meet these stresses when acting in combination.

The joists, which act as the principal supporting members of the floor construction in their first form as delivered to site, contain the tension member in the shape of a corrugated bar of mild steel embedded in their lower thickened portions. These bars, as well as the concrete sections in which they are embedded, are closely proportioned to the spans to be covered and the loads carried. Shear reinforcement is not required since the disposition on centers and the concrete section provided is ample to meet this and this distance between centers is maintained in all depths.

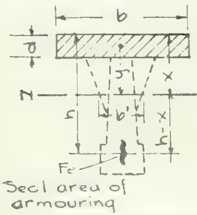
For static calculation no attention is paid to tubes lying between joists. These act as displacers only and as centering to receive the top layer concrete. By the addition at the site of a top layer concrete, which flows around and grips the upper portion of joists, the combination is completed and the compression area has been added to the floor. In calculating strengths no consideration is given to joist concrete in compression; that portion only of top layer, $b \times d$, lying between centers of and over adjoining tubes, is calculated in compression and as acting at its center of pressure y, relative to the section of steel in tension Fe, acting at its center of gravity. The neutral axis, $N\ A$, passing through the concrete of joist and adjoining sections on either side of the top layer concrete affords at b a sufficient sectional area to take up horizontal shear stresses, while, as before stated, a sufficient area is provided in joist section *plus* steel to take care of vertical shear stresses.

In a very great number of experimental tests carried to destruction, no instance occurred indicating in the slightest degree a tendency to part between the top layer of concrete and joists. It is evident that these become monolithic. Tests under the severest possible conditions upon test panels formed of three or four joists, reveal the satisfactory nature of the design premises and in many instances where a factor of safety of four was assumed, a factor of six was actually obtained, while in no instance where the work or tests were carried out in accordance with standard specifications and tables has the safety factor obtained been less than four.

In a large measure, the entirely successful results obtained are due to the simplicity and efficiency of the shop manufacture of bearing units or joists which are made under conditions insuring the densest possible concrete while that one essential in all reinforced concrete work, the accurate location of the reinforcement, is fully safeguarded.

The concrete joists are cast upon wood molds, shaping one side and then run to proper section on the upper surface with a template. They are then slid over upon drying racks where in two days' time it is possible to turn them up on edge until sufficiently matured for deposit in storage piles. The length of reinforcing bars serves as a guide to the total length of joist required. It is therefore possible, as soon as plans are definite, to proceed with the manufacture of floor units as soon as the foundations are begun, these units being fully matured and serviceable long before they are required. In fact, it has not been uncommon for floors to be ready to lay down months before supports were available to receive them.

For ease of construction, this system is unrivaled; where isolated loads occur it provides at once for these by placing the necessary number of joists side by side; it can be trimmed to openings as readily as a wooden floor, the tube spacers can be arranged to serve as vent or flue spaces, while cuttings to admit of the passage of pipes, etc., through the floor are most readily and quickly made. The actual concrete surface of the floor can be leveled and tooled off as a finished floor surface, thus completing the work at one operation, or subsequent finishing layers of other materials can be readily applied. It is increasingly the practice to float off level and finish with linoleum or cork carpet fixed by adhesive to the concrete. For offices, schools, apartment blocks, hotels, etc., the soundproof qualities of the floor render it highly desirable while its fireproofing qualities are of the highest standard.



Steel stress should not exceed 14000 lbs. per sq in.
Concrete in compression limited to 600 lbs per sq in., concrete in shear to 60 lbs per sq in, and concrete adhesion to steel to 100 lbs per sq. in.

$n = 15.$

$$x = \frac{2 \times n \times Fe \times h + b \times d^2}{2(n \times Fe + b \times d)}$$

$$y = x - \frac{d}{2} + \frac{d^2}{6(2x-d)}$$

∴ distance between centers of pressure and tension equals $h - x + y$, consequently maximum tension in $Fe = \frac{B.M}{Fe(h - x + y)} = {}^{s}Fe$, and the maximum compression in concrete $= \frac{{}^{s}Fe \times x}{n(n-x)}$

Design Detail of Unit Beam

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*Edmonton, Alta.

[1] This was described in detail on p. 153 of the Mar., 1913, issue.

The Nature of Laitance in Concrete Work

In the current issue, the Public Works Officer of the U. S. Navy Yard Boston, discusses a "laitance" found in repairing some of the work cast under water in Boston Harbor. The term "laitance" is itself French, but it has been adopted in the U. S. and in other English speaking countries, to designate a light paste-like substance which is held in suspension in the water when the concrete is mixed too wet or when it is deposited under water. Taylor & Thompson[1] give the following analysis of laitance:

Silica (SiO_2)	6.00%
Alumina and Iron (Al_2O_3, Fe_2O_3)	8.66%
Lime (CaO)	47.40%
Magnesium Oxide (MgO)	2.40%
Ignition loss	23.60%

If calculated to a water and carbonic acid free basis the analysis becomes:

Silica (SiO_2)	20.94%
Alumina and Iron (Al_2O_3, Fe_2O_3)	11.30%
Lime (CaO)	62.04%
Magnesium Oxide (MgO)	3.14%

The same authors quote Clifford Richardson (cons. engr., N. Y. C.), as follows:

> I have had a thin section ground, but find that it shows no structure which is characteristic. The section consists largely of amorphous material of an isotropic nature, that is to say, it does not affect polarized light. It reveals a considerable amount of a yellow substance which seems to be the undecomposed magma contained in the original cement. I have formed a material very similar to the 'laitance' by shaking Portland cement with water, decanting the finer portion and allowing it to settle out and harden. This material, like 'laitance', is rather soft. This is due to the fact that the Portland cement is much more thoroughly decomposed under these conditions than under ordinary ones, thus accounting for its character.

The evident conclusion is that this substance is one which in some way is abstracted from the concrete by excess of water. This should be prevented, when possible.

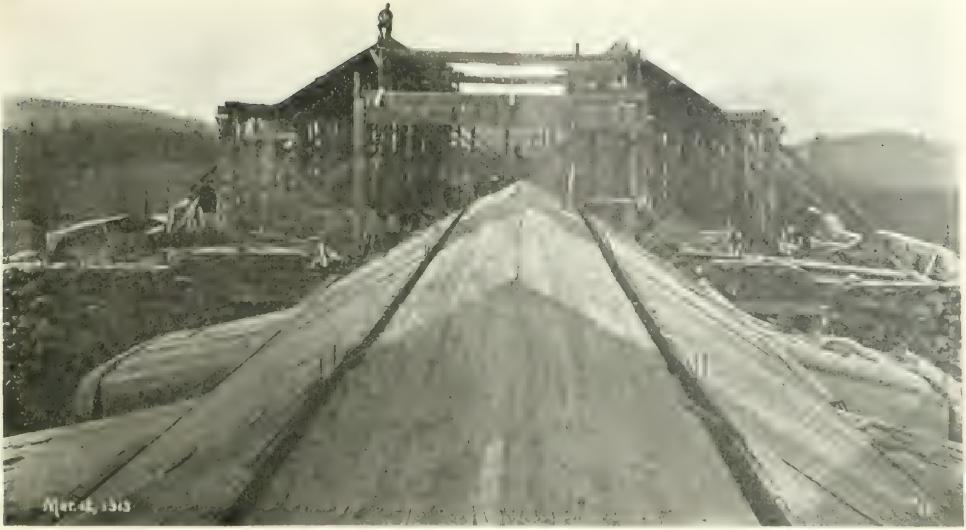

FIG. 1—DETAIL VIEW OF ROOF CONSTRUCTION ON A NEW HOTEL AT ASHEVILLE, N. C.

The centering in the foreground is ready for steel. In the longitudinal sections at the right and left the stirrups are in place. The staples are to hold the slab steel in place. The rods are hooked over the [illegible] as shown in Fig. 2

General Features of Mountain Inn

Down at Asheville, N. C., where God was lavish in dispensing mountain majesty and entrancing scenic beauty, there is being built a hotel. It will be called Grove Park Inn and its owner and builder, E. W. Grove, says it shall be the finest tourist hotel in the world, though not the largest. The structure will be 396′ long and 80′ wide. The "Big Room," as they are pleased to term what is usually called the lobby, is 80′ by 120′. There are six columns, which together with the ceiling and beams, were cast in place. The columns are 30″ x 30″ and 23′ 4″ high and designed to carry a load of 300 tons each. The beams are 24″ wide at the bottom, 60″ deep with a 24-in. flare at the top. Pouring the concrete, a 1:2:4 mixture, into the forms was begun at 7 a. m. one Monday, and continued uninterruptedly until 7:30 p. m. the following Saturday. The day force poured the slab or panel work, the night force poured the beam work. In all beams and posts ¾-in. and ⅞-in. square twisted steel bars were used, crossed at short distances and tied. Over 600 bbls. of cement were used in this floor alone.

The walls of this unique structure are of granite quarried from the mountainside, nearly all laid in cement, while the outer face of the walls is covered with rough mountain boulders as they were taken from their mountain beds. This produces a wonderfully rugged, but picturesquely beautiful and unique effect. All floors are of concrete, with a 30-in. border of silver gray tile. There will be no wood used in constructing the building save the doors and door frames, windows and window frames.

About 20,000 bbls. of "Clinchfield" Portland cement[1] will be used in the construction of this building, which will open July 1, 1913. The Southern Ferro-Concrete Co., Atlanta, has the contract to do all the concrete work.

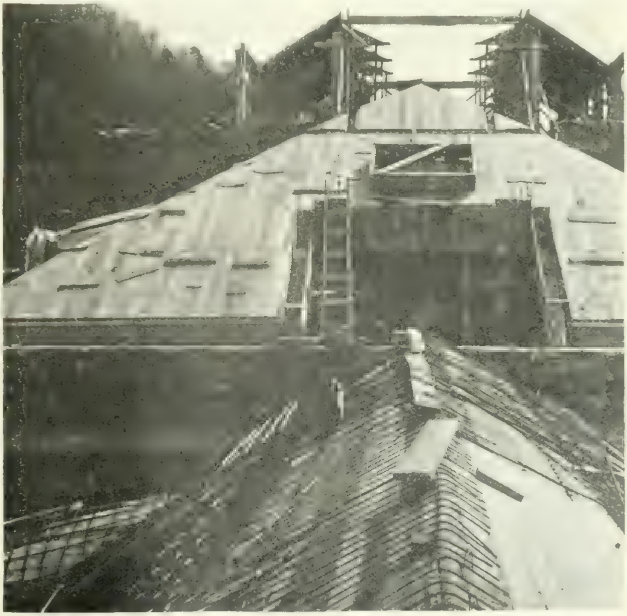

FIG. 2—DETAIL SHOWING THE STEEL IN PLACE AND THE CENTERING FURTHER ADVANCED ON THE ROOF IN THE BACKGROUND

Figs. 1 and 2 show the work Mar. 12, 1913

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[1] Clinchfield Portland Cement Corp., Kingsport, Tenn.

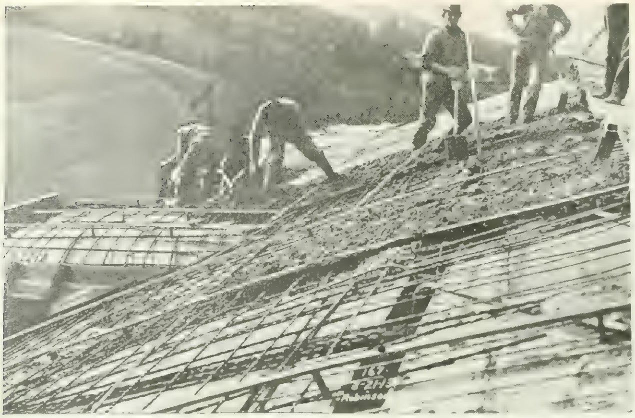

Fig. 3—Running Concrete on an Inclined Roof

This is at the end of one of the gables, showing the approximate point from which the views shown in Figs. 1 and 2 were taken. Note how the steel is securely positioned. Note also the wood stretcher templates used to indicate the top of the slab. The concrete is wheeled on a runway built along the ridge, shown at the right. This view was taken Mar. 21, 1913

Although this building is unique in construction throughout, the roof affords one of its chiefest features of interest. In will be one 5½-in. reinforced concrete slab. The estimated weight of the twisted steel bars in the roof is 90,000 lbs., in 6-ft. to 35-ft. lengths. This concrete slab cover is to receive a special roofing, consisting of first, a priming coat; second, a coat of Trinidad hot asphalt; third, felt paper laid on and rubbed while asphalt is hot; fourth, a second coat of Trinidad asphalt; fifth, a second layer of felt paper rubbed on.[2] Over this special treatment of the cement slab will be laid red tile shingles,[3] 6" x 13" and ⅜" thick. These shingles will be fastened on by a copper-clad nail, through holes in the shingle into the special 5-ply covering and sand and cement finish coat of the concrete slab.

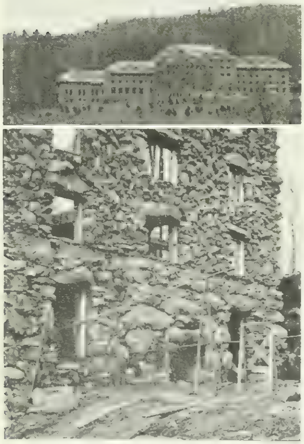

Fig. 4—Above is Shown a General View of the Structure From a Distance Below a Detail Showing the Wall Built of Natural Stone

Around the dormer windows will be arranged narrow tile, laid in irregular courses, which will give the effect of thatched roofs seen on many interesting old buildings abroad. To carry out this thatched effect, there will be no peak, or comb-board on the roof, but the peak will be rounded and covered with a No. 14 spun copper sheet, so that from the ground the eye will not be able to detect the difference between the copper peak and the tile shingles. There will be no angles in the roof, but all turns made along lazy, graceful lines that flow downward, rather sharply drooping over to the eaves which extend beyond the main walls about 5 ft. The plumbing and heating pipes and electric wiring of every kind will be concealed in conduits in the walls, and the radiators will not be seen in the room, being concealed under the windows. No electric bulbs will be seen, all lighting being done by the indirect system, best of all.

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[2] Roofing applied according to specifications of the H. W. Johns-Manville Co., N. Y. C.

[3] Murray Roofing Co., Cloverport, Ky.

In *Concrete Engineering* for Sept., 1908, a complete description of the first factory built for the Robert Gair Co., Brooklyn, was published. This building has always been of interest because it occupies a commanding position just north of the Brooklyn end of the Brooklyn bridge. It was built when structures of this type were not so common and its design and construction attracted much attention. It is of interest, therefore, to know that the Turner Construction Co., N. Y. C., who were the contractors for the first building, have been awarded the general contract by the Robert Gair Co. for the construction of another 10-story building to be erected adjacent to the first building. The new building is 200' x 125' in plan, and will be of reinforced concrete throughout. The Robert Gair Co. manufactures paper goods.

Concrete Floor Finish and Its Execution

BY L. EID*

Reinforced concrete construction in buildings requires a great deal of cement finished surface. These surfaces are subject to a great amount of hard service, such as wear by walking, abrasion by moving and sliding of different articles over them and by trucks carrying heavy loads.

The following question therefore is heard often from owners or prospective owners of such buildings: Can a concreate floor be laid that is entirely satisfactory for our use? The common cause of complaint by these men is mostly the dusting of these concrete floors, tending to harm articles, merchandise, or machinery.

That a finished cement wearing surface can be produced to endure any possible traffic in a building to come on it without creating this annoying dust, there is no doubt. It was done before the era of concrete-steel construction set in and we are doing it today by following closely the instructions and principles laid down in the following paragraphs:

At the start of the new era of concrete construction, the finishing coat was applied to the structural or sub-floor immediately after the completion of the first stages of the setting of the concrete. Every detail in this operation was about the same as practiced in a sidewalk or paving job, except that detail of water referred to later. In the haste with which the average reinforced concrete work went on, no time could be lost for proper maturing of finish. The raising of the next story's falsework followed immediately and the surfaces were greatly marred by the handling of lumber and the walking. After wrecking it was noticed usually that things were in bad shape and patching had to be resorted to. To avoid the latter and to save the time it took to do the finishing, it became an almost universal custom to apply the finish after the completion of the building.

For a better understanding of what is to follow, I state beforehand that in our opinion a concrete will be strongest when prepared with the least amount of water necessary for the completion of the chemical process, always assuming of course that it is well worked for its maximum density. Any amount of water above that amount so required will decrease the strength of the resulting product. We speak of cement as being *killed*. when water in excess of the amount that can be assimilated by the chemical process accumulates between the particles of sand and cement during the hardening period.

Surplus water: A common fault in putting on finish is superficially to wet the floor prior to depositing a sloppy layer. This is rodded off and the cement finisher begins with float and then applies the trowel to produce the smooth, even surface. The pressure of the tools then causes the surplus water to rise to the top. I have seen cases where water was standing ¼" high over the general level. The water will generally disappear in about 25 min. to 30 min. and in fairly warm weather the mortar will in that time take its initial set, so that a final troweling can go on without any water appearing again. The water has simply disappeared in the mortar, placing itself between cement and sand particles, and preventing their complete union. The second troweling will not again bring the water to the top, as the whole mass has lost its plastic qualities; it has taken its initial set.

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*The L. Eid Concrete Steel Co., Cincinnati.

The resulting coat is, therefore, a weak product. It will not stand wear, hence the dusting caused by walking and trucking. This weakness is directly proportional to the surplus of water used in top coat.

Dry Base Course: The second cause of soft finish is the insufficient wetting of sub-floor, preparatory to putting on the top coat. The relative dryness of slab will withdraw the water from the comparatively thin coat, so that when the hardening begins the finish coat has not enough water for the process.

Inefficiency of Top-Wetting: We come now to the third cause of weakness, viz: the failure of the later wetting of the completed top surface to supply the water lost by evaporation. The water so supplied will not enter very deeply and will not remedy any trouble caused by the mistake mentioned under the second cause.

The second and the third cause are more harmful in a thin top coat, and the damage by neglect is somewhat lessened in using a heavier top coat. Such thick finishes, however, must be either rammed thoroughly or be put on in two or more layers, each troweled or compacted for itself.

In dense mortar as well as in dense concrete, the surplus water is held a great deal by capillary action and it follows therefore that dense mortars, and mortars with fine sand are more affected by superflous water than coarse, aggregate mortars. It may be noted then that using a coarse sand, such as granite with the dust screened out, the water will often sink down quickly to the slab and, if the surplus is not large, be absorbed there before doing much damage.

Lack of Bond: A fourth cause of complaint is the loose finish, the finish that is not completely bonded to subfloor or base. This may be the result of different causes. One is the shrinkage of finish during the hardening process and the consequent setting in of shearing stresses between the lower layer of the finish coat and the old subfloor that has already gone through the main shrinkage process. The finish usually pulls loose. A thin finish may break, causing cracks on top surface, and still remain bonded in sections to the under floor; the heavier finish is too strong and the shrinkage will shear it off at its lower plane.

Rich mortars will naturally shrink more than leaner mortars and are a further cause for loosening. A 1:1 mortar should never be used and 1:2 mortar should be the standard. We often find the finish loose around the joints, although the central portion is apparently tight. The above mentioned rich proportions will explain this phenomenon. Upon further investigation, digging up the finish, etc., it will be found that only a very weak bond has been developed and that the finish is easily separated from its under course. The outer edges are generally curved upward, in this case, and the whole block is somewhat dished, so that water will stay in the center.

Another easily understood cause of loose finish is that the mortar is not well rubbed in; insufficient pressure is applied with the trowel to cause the mortar to work into the pores of the underlying course. Also these pores are mostly clogged up by flying dust or dirt, and some method must be used to clean and open them again.

A Suggested Specification

The foregoing remarks will serve us now for the skeleton on which to construct a good, hard finish of the quality produced by the better workmen of 20 years ago.

The leading features are:

Wetting of sub-floor: Use water profusely and continuously for at least 36 hrs. previous to beginning the cleaning.

Cleaning of top surface: Use flowing water, brooms and brushes; open the pores again with diluted muriatic or sulphuric acid.

Putting on finish: This should be put on in two layers, the lower layer very wet and the upper layer only moist, the consistency of moist earth. These layers are of the same mixture. To the lower layer should be added water to make it flow easily under the pressure of the trowel. It must fill out the minute crevices and its cement will enter into the pores of the substrata when the rammer is used later on the second layer to compact to a high degree this real wearing or top course. Of course, a man with a trowel would be unable to pack such dry mortar. For this purpose the rammer must be used. Under its pressure, the surplus water will flush the cement in the lower course and cause it to enter the pores of the old concrete in the base course and the remainder will rise to the top to make the top layer plastic enough to permit later floating and troweling. Any spots appearing too wet are dug out and replaced by new moist mortar and freshly rammed. It should be floated once only, and then gone over with a finishing trowel.

After the proper setting of the finished top coat this should be covered with straw and kept wet at least four days in hot weather, and longer in colder weather. The straw can be used over again. No loose finish, but a hard, solid wearing surface will be the result, if these recommendations are followed. Granite can be entirely or partly substituted for sand, or granite or other hard aggregates can be thrown over its top with sieve and rammed down previous to troweling. This method has been followed by us for the last six or seven years and we are satisfied that it has saved us a good many troubles and many disappointed customers.

To illustrate our method, I will show it in particular for a building.

Hand mixing may be followed for finish as usual, but for a fair sized job, we use a small mixer, equipped with gasoline engine, to mix the mortar. A mixer on the order of the Blystone[1] is very suitable, as it allows the close regulation of the necessary water, which is so essential. A man is assigned to start watering of floor sometimes two days ahead and at the same time, he, with other men with long hand chisels, removes any laitance or old mortar on the floors—the latter generally leakage through falsework while the concrete for the next higher floor was being poured. He wets the floor until the water has penetrated well into the body of concrete. This is followed up the next day and evening and sometimes at night, or at least in the early morning. Then the brooms and long handled brushes are started to clean the floor. Running water follows the brushes to flush any finer particles from the surface.

The last step for cleaning is the application of diluted acid, using 1 part of acid to 2 or 2½ parts of water. The acid in its diluted form is standing mixed in a barrel before starting this operation. The acid will attack and emulsify the finer dust that clogs the pores and will open up new ones by attacking and partly disintegrating the cement or the aggregates. A wooden bucket is used, with a spreader. The acid is applied evenly by one man, while another man with a broom follows and spreads it more evenly. The action is rapid and only superficial. Very soon the effervescence stops and the streams of water, with the help of brooms, float every trace of it away. Water is used generously.

The cleaning process is now ended and the application of the finish has to follow immediately. The first layer is applied about ¼ in. to ⅜ in. thick, spread on floor, wetted additionally with a sprinkling can and the finisher starts with his finishing trowel to spread more uniformly by working with the added water, pushing and floating the mortar around so as to make it certain that every spot has been reached. While he is working thus, the wheelbarrows arrive with the almost dry or only slightly moist mortar. A man is setting gauge strips and others are spreading out with shovels the top coat of mortar high enough so that when rammed there is surplus material for rodding off.

The rammer is generally a steel plate, 12" x 12", and about ⅜" thick, with malleable iron flange and wooden handle, and weighs about 18 lbs. Under the blow of such a rammer a mass of concrete will be compacted to a high degree and the surplus water in the lower course may enter partly, but little, the sub-floor; the rest will permeate the drier top coat and some will then appear on the top surface, just enough for the finishing.

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[1] An open-drum mixer, in which the mixing is done by revolving blades; built by the Blystone Machy. Co., Cambridge Springs, Pa.

Wherever there is a spot showing too much water, this is removed and replaced by drier material and newly rammed. No excessive wetness at the top is tolerated. Sometimes a little dry material, just before rodding off, is used to dry up and is rammed with the float. The rodding off, the floating and the troweling are as usual, but require more exertion. To go over once is sufficient, as the compacting process is done with the rammer and the finishing proper can be done by going over once. Very soon after setting the finished surfaces are covered with straw to prevent evaporation and better to hold the water that is added continually and liberally from time to time. Such a floor is bound to be hard and tight to the under floor.

I do not believe in making finish of anything but Portland cement and sand; the so-called hardeners, composed mostly of iron which is to be rusted later by the sal. ammoniac mixed in the finish, I consider rather dangerous than beneficial. The oxidation, after the hardening, will be accompanied by swelling and by this action the strength of the finish is reduced instead of increased. I think that iron powder in the form of an iron oxide (Fe_3O_4) which does not corrode any further and which may simply be spread over top, may be useful.

For good results under any condition, all finish should be applied, we believe, following approximately the above methods.

"It is generally accepted that the best method of finishing a concrete pavement is to wood-float the surface after it is struck off with a template," said C. W. Boynton in a recent paper, "Sometimes the floated surface is brushed with a stiff fibre broom; but this is not necessary and is not recommended. It is considered advisable to corrugate all grades of 5% or more. At Davenport, Ia., the corrugations were made with a roller on which the projections were staggered. They were 6" long; 4" on the roll were staggered."

There is situated at the little village of Hordle, some four miles from Lymington, in Hampshire, England, what is believed to be the highest sepulchral monument in Europe. This monument forms a landmark for miles around, and is stated to be built of cement concrete. The tower is stated to be about 300 ft. high, and to have been erected by the late A. T. T. Peterson some 40 years ago to prove the durability of concrete as a building material. Mr. Peterson died a few years ago, and left instructions in his will that his remains were to be deposited in this tower, where they now rest.—*Concrete and Constructional Engineering.*

Methods In Painting Concrete Surfaces[*]

BY L. P. NEMZEK[†]

There are two reasons for treating concrete surfaces, namely, to preserve the structure against forces which exert deteriorating influences, and to improve the appearance or lend beauty thereto. Unfortunately, in obtaining the desired decoration, frequently at the lowest possible cost, the proper methods of application are sadly neglected. Furthermore, it is within the past 10 years only that the matter of treating concrete surfaces has been forcibly brought to the attention of the master painter, thereby opening up a field which presents innumerable opportunities with regard to the application of satisfactory coatings.

To combine protective and decorative qualities it is necessary to have in mind not only those things which will lend beauty, but how they must be applied in order to promote the life of concrete, at the same time insuring maximum service of the coating. It is advisable to study the properties of the constituents of cement and concrete in order to determine how they affect the stability of the structure, and also how they affect the coating applied over them.

Concrete surfaces may be divided into three general classes. First, interior walls of plaster (sand or smooth finish) and cement; Second, cement and concrete floors; Third, stucco, cement and exterior concrete surfaces. The conditions to be considered are very much the same in each of these surfaces, and the treatment given should be practically the same. It would not be practicable to prescribe a set formula to apply to all cement and concrete surfaces. While they are very similar, it is necessary for the painter to use his judgment and experience, making such slight modifications as each particular case requires. The age of the wall, its environment and the character of the finish are factors which will modify the treatment necessary in order to obtain the best results.

For the reason that lime has a saponifying action on oils, and furthermore, recognizing the fact that all cements and concrete construction contains alkali in varying amounts, the first matter to consider is how to treat the surfaces in order either to eliminate this material by neutralizing it or in some manner to keep it from exerting its harmful influence on the vehicle portion of the paint which is to be applied. A treatment which has for its object the elimination of whatever free alkali is present on and near the surface in many instances proves injurious to the structure. The use of mineral acids while neutralizing the lime, will detract, we believe, from the life of concrete construction. Solutions of materials that change the lime to insoluble salts, which do not act on oils, have been suggested from time to time and have been used with varying success. What is known as the Macnichol zinc sulphate treatment has proven very successful for the treatment of interior walls before applying prepared flat wall-finishes, or other coatings. It is very generally recommended, and its satisfactory character is based on the reaction which changes the free lime to the sulphate form, the latter possessing no saponifying action on the paint which is subsequently applied. This treatment has given excellent results on walls which are free from permeation. On walls, however, through which moisture from some source or other forces its way, the soluble salts present throughout are dissolved and are brought to the surface, where they give rise to such undesirable conditions as staining, etc., and upon the evaporation of the moisture, efflorescence develops.

Before applying the solution of zinc sulphate, it is desirable to go carefully over the walls, removing all dirt, grease and loosely adhering particles of concrete, at the same time filling up any broken parts of the surface and cracks. The surface should then be allowed to stand for at least 48 hrs., in order to allow it to dry out properly, and in order to obtain full benefit of the neutralizing properties of the solution. The use of water-solutions is undesirable unless the surface has ample time to dry out. The excess zinc sulphate should be brushed off before applying the paint.

Wherever possible, the surface to be coated should be allowed to stand from three to five weeks in order to give it time to dry out. The undesirable effects obtained by the presence of alkali in the concrete are also lessened when the surface is allowed to stand for some time.

Considerable attention has been given to the painting of cement and concrete floors, as there are many reasons why such coatings are highly desirable and, in many cases, absolutely necessary. The absorption of grease and oil tends to disfigure a floor, and some of the best authorities on concrete construction are of the opinion that a considerable number of these materials have a disintegrating action. Many mineral oils, when allowed to penetrate into concrete that is not thoroughly dry, promote disintegration. Old surfaces do not show any noticeable indication of deterioration, however.

The floor is made sanitary by painting, because it can be kept clean and free from dust and dirt. All opportunity for "powdering" is overcome by the thin film of paint which, when properly applied, has a firm hold within the mass of concrete, and besides eliminating the possibility of surface wear, makes an impervious coating which prevents the absorption of moisture. This coat will withstand the action of forces which would readily disintegrate the untreated concrete. Oils and grease are kept from penetrating into the concrete. With reference to the finish, outside of natural wood stains the same color properties and decoration can be obtained on concrete floors that are possible by the painting of wood.

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[*] An abstract of a paper read before the 29th annual convention Int. Assn. Master House Painters & Decorators of U. S. and Canada, Denver, Col.

[†] Gibbsboro, N. J.

In applying the paint two factors must be given careful attention. While the pigment is a requisite of considerable importance, the vehicle will, in almost every instance, determine the wearing properties. Floors are subject to hard usage, and must stand severe strains. It is necessary, therefore, to use a material which will oxidize to a dry film and which will retain sufficient elasticity to withstand the strains to which it is exposed. Ordinary floor paints which prove satisfactory when used over wood give like results when used over a properly applied filler. The wear closely resembles that found on a wooden floor. The paint coat invariably possesses better bond within the concrete and the service in many cases is superior to that obtained from the same paint applied on wood.

Natural wear will gradually make necessary the repainting of floors. It is not necessary to apply a filler again. One coat of paint, well brushed out, gives the best results. In preparing the surface for repainting, no strong alkali should be used for cleaning, as it will not only act upon the paint, but, if not thoroughly removed, will also affect the following coat. It is advisable to go over the surface with warm water and soap and allow sufficient time to elapse for drying.

Paints made especially for cement and concrete surfaces show improved wearing properties when applied over a filler. This was found in a test comprising all of the leading brands on the market. Considering that it is chiefly the vehicle of a paint which is acted upon by free alkali present in concrete, and with the knowledge that up to the present time all those vehicles which give good results are saponifiable, it is easily explained why paint applied over a surface which has been treated to correct for the alkali will give better results than if certain portions of a paint, no matter how scientifically constructed, must neutralize the objectionable forces at work, when as a natural consequence in so doing the bond within the structure is weakened or broken in places.

North Carolina Residence With Double Monolithic Walls

The accompanying illustration shows a southern residence recently built for Raphael W. Pumpelly, president of the Piedmont Plantation Co., at Samarcand, near Eagle Springs, N. C. The architect is Chas. G. Loring, Boston. The outside walls and most of the inside partitions were built with the Van Guilder[1] hollow wall machines and form double monolithic walls with a continuous air space between them from foundation to roof plate, literally one house within another, the walls not touching each other at any point. The continuous air space effectually insulates the walls so that no dampness or frost penetrates them and there is no condensation on the inner walls, although the plaster was put directly on them without any furring or lathing and the stucco was applied directly to the outside walls.

The house is dry and easily heated. In summer the air space between the two walls keeps the heat out, making the house refreshingly cool. The walls are firmly bound together with rods of steel and both walls are thoroughly reinforced horizontally.

The interior is very simple, with fireproof construction to a large extent; the main partitions are of concrete, sound-proof hollow walls and the floors on the first story are of cement and tile. The greater part of the wall surfaces are tinted plaster, and the fire-places are mostly cement with colored tiles inserted. There is very little wood trimming, except with the built-in book-cases and window-seats. The entire building and grounds are laid out in northern Italian style of country houses. The outer walls are old rose in color and the roof is a green Spanish tile.

The walls of the terrace in front of the house were built with a double wall machine. It is a substantial and beautiful example of that popular method of construction. It was built in 1911 and was so satisfactory to Mr. Pumpelly that in 1912 he erected a large sanitary dairy barn and silo by the same method.

The Chicago Cement Show

In other pages of this issue is published the report of an extensive canvass conducted by Concrete-Cement Age to find out what exhibitors at Cement Shows felt to be the best time and location for the Shows. The report has been in type for some time, and just as the paper goes to press it is announced that the Seventh Annual Chicago Cement Show will be held in the Coliseum, Feb. 12-21, 1914. The Coliseum has again been leased by the Cement Products Exhibition Co., 72 West Adams St., Chicago, for the next national Cement Show for a period of nine days. The show will open on the evening of Feb. 12; and close on Saturday evening, Feb. 21. This is a longer show than has been held heretofore, but as there will be only one show next season, it is felt that larger benefits will be derived by extending the show two days longer than formerly. While the exhibition will be conducted along the same general lines as in the past, a number of changes have been adopted. In addition to holding the show open for a longer period, the space units have been increased in size and the rates for space decreased. Some innovations in the way of booth equipment are also in prospect.

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[1] Van Guilder Hollow Wall Co., Rochester, N. Y.

A Concrete Residence at Samarcand, N. C.

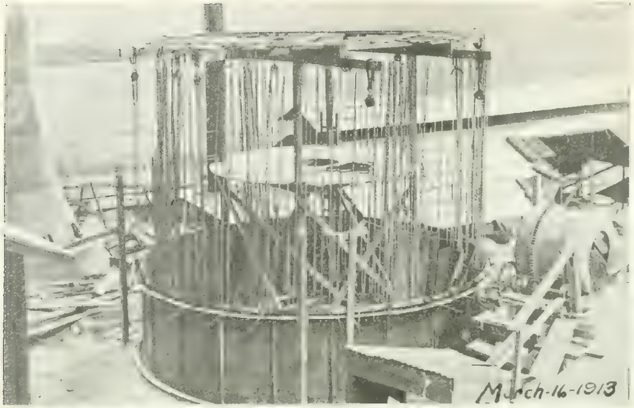


Fig. 1—Starting the first course of forms for a Concrete Chimney

This view, taken Mar. 16, shows the foundation completed, the staging up and the forms ready for the first course

A Concrete Chimney on the Pacific Coast

The Mar., 1913, issue presented a description of special types of tapering reinforced concrete chimney. The accompanying illustrations, which are made from photographs forwarded by W. F. Kett, gen. mgr. of the Mountain Copper Co., Martinez, Contra Costa Co., Cal., show very plainly this method of chimney construction in operation.

The chimney will be 220′ in height above the foundation, the foundation itself being 75′ above sea level, making the total height of the stack above sea level, 295′. The present iron chimney which has been doing service at the works since the plant was established, is 175′ in height with the foundation 50′ above sea level. The new stack is being erected on the summit of the knoll immediately west of the present stack and will be built of reinforced concrete. The greatest outside diameter will be 19′ 4″ and the interior diameter at the top of the stack, which will taper slightly from the foundation, will be 12′. The foundation will be octagonal, 35′ in diam., and will be sunk 5′ 6″ below grade. The interior of the stack is to be lined with red brick and acid-proof mortar and running up the outside will be a steel ladder for use in case of repairs or emergency work.

The contracting engineers for the work, the General Concrete Construction Co., Chicago, guarantee the chimney against disaster for a period of five years. The great stack will withstand a wind velocity of 125 miles per hr. and an interior temperature of 1,000° F. The contract calls for the completion of the job within 120 days from the start of the work. To fulfill the terms of the contract the builders put up a bond of $15,000.

Steel forms are being used, which will be raised as required and which will also leave a smooth outer surface. The outer surface will be washed down to produce a white chimney.

The foundation is a combination of an octagonal slab 2′ 6″ thick uniformly, and a truncated octagonal pyramid 3′ thick, the top of which is an octagon circumscribing the greatest outside diameter of the chimney. The shaft starts at the bottom with an outside diameter of 19′ 4″ and tapers at the rate of 1½″ in 5′ to 13′ 10″ at the top. The concrete wall is 15″ thick at the bottom and 5″ thick at the top. The inside of the concrete shaft is 13′ in diameter at the top, permitting a 2″ air space, and a brick lining wall 4″ thick, leaving a clear diameter inside of the lining of 12′. The inside of the concrete wall tapers slightly less than the outside, owing to the increasing wall thickness, but makes room for increasing the thickness of the brick lining wall, and also provides a wider air space to insulate the outside concrete wall from the effects of high temperatures. The lining obtains additional support from brick pilasters built with and bonded into it, at six points on its circumference, 8″ wide and extending out into the air space within 1″ of the concrete wall. This outer wall is vertically reinforced with square twisted steel bars, sufficient to absorb all strains resulting from a wind of 125 miles per hr. velocity, on a basis of 16,000 lbs. per sq. in. working stress. The vertical steel is surrounded from bottom to top by strips of very heavy woven wire fabric, consisting of horizontal wires ¼″ in diameter, spaced 4″ apart vertically, woven triangularly, and tied at intervals to the vertical steel bars. All vertical bars are embedded in the foundation to a depth of over 5′ and every second bar is bent under the net of steel bars which reinforce the foundation slab. The shaft is topped off with an ornamental head, consisting of a flared drip course, and two rows of vertical panels, giving it a fluted appearance, also two belt courses which frame the lower row of panels. The amount of reinforcing steel varies from 156 ¾-in. sq. bars at the base to 24 ¾-in. sq. bars at the top.

The scaffolding shown in the cut is extended as the work progresses, and forms a braced tower from the bottom of the chimney to its top. The working platform is carried up with the heavy timbers which support the chain blocks. There are eight of these hoists on a

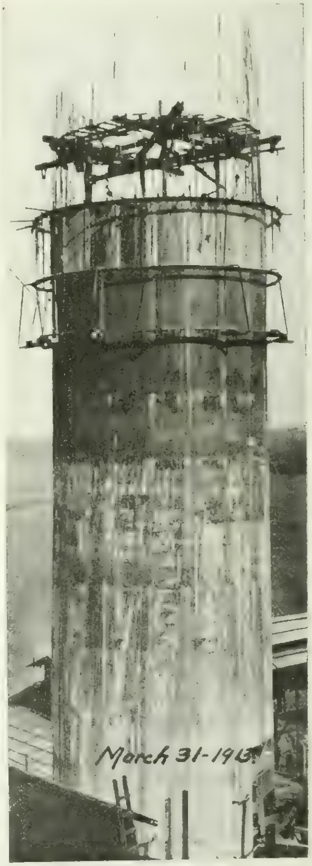


Fig. 2—This shows the same Chimney Fifteen Days Later

This illustration, dated Mar. 31, shows 11 sections, (55′) of the concrete shell completed chimney of this size, and it is noteworthy that they carry all the weight of the steel forms, and that the green concrete has only its own weight to support. The ½-cu. yd. mixer and the hoist are motor driven by power secured from the Mountain Copper Co.

The aggregate employed in the concrete is a very dense, heavy slag from the reverberatory furnaces, and makes excellent concrete.

The main object in building the new chimney is to secure a greater draft for the furnaces, the need of which has long been felt and which it was aimed to secure last summer when plans were adopted for adding to the present stack. In addition to affording a better draft the new chimney will permit the passage of a greater amount of air which will dilute the gases from the furnaces even farther than at present.

The chimney site is as prominent as any point near San Francisco, being on a knoll on the bank of the Sacramento river, 38 miles from San Francisco, and commanding a view of the entire valley. It can be seen from every railroad entering that city from the east, and will doubtless soon become a landmark.

A New Concrete Wall and Stucco Coat on Old House

The accompanying illustration shows an old brick house made to look like new with the aid of stucco and a solid concrete addition, together with a concrete wall. It is the residence of Rev. F. E. Huber, Marshall and Violet Sts., Norristown, Pa. T. V. Smith was the contractor on the remodeling and the new work. The original dwelling is of brick construction and the annex is of reinforced concrete made of crushed slag. All of the walls were covered with Portland cement stucco, with a second coat in which Atlas White Portland cement was used and given a sand finish. White cement was not used on the portion of the wall up to and including the water table, and here the gray cement gives a pleasant contrast. The concrete wall in front of the building is 155′ long and at the front approach to the house, there are 20 steps, the first 10 leading to a landing and 10 more to the top. At the side of the house the wall is 358′ long. On the side street, the wall is 7′ high above ground and 3′ below ground. It is 3′ thick at the bottom and the coping on top is 18″ thick. The front wall projects 5′ 6″ above ground and 3′ below ground. The entire wall is finished like the house itself, using white Portland cement—a brush coat. The wall cost $7.00 per running yard.

"The prettiest concrete floor is not the best wearing," remarked Leonard C. Wason, president of the Aberthaw Construction Co., Boston, recently. Mr. Wason stated that a nice appearance is given to a concrete floor by the small particles of sand and pebbles, but these break down. For long service the best floor is the one made with the coarse material near the top. After a while this floor wears down to the coarse material and then looks like a terrazzo floor. "It is quality rather than the high polish that counts in concrete floors," stated Mr. Wason, "and it is a pity more manufacturers do not realize this." Mr. Wason also remarked that it is very hard to get a good wearing surface and a good-looking finish at the same time.

A striking instance of the peculiar vibratory, or non-vibratory properties of concrete is shown in the fact that a bell, cast in concrete, will ring almost like a metal bell, but a slight touch of the hand serves immediately to stop vibration and the resulting sound. This is due to a lack of homogeneity from the standpoint of sound transmission. It suggests at once the ease with which concrete structures are made soundproof.

A thin layer of cork, cinders or sand between floor tile of concrete or ceramic tile and the body of the floor will entirely shut off the transmission of noise from traffic. Practical immunity from noise of traffic on most concrete floors is secured by laying linoleum.

The Inspection of Reinforced Concrete Work

In framing its building code, the city of Los Angeles is endeavoring to enact a comprehensive and effective statute which will throw every safeguard around concrete construction, without restricting it. Following is the text of a report of the building ordinance commission, relative to the clause covering inspection of concrete work:

The entire subject (of concrete inspection) has been carefully considered after consulting with committees representing the architects, engineers and builders of this city. We are agreed that:

1. The record of reinforced concrete construction in this city shows that there has been no failure where the work has been done by men experienced in this class of construction, or that which has been under the supervision of a licensed architect or an engineer of recognized standing.

2. No city, so far as we can ascertain, gives such minute inspection of structural operations as to relieve the architect, engineer, owner or builder of the responsibility of inspection.

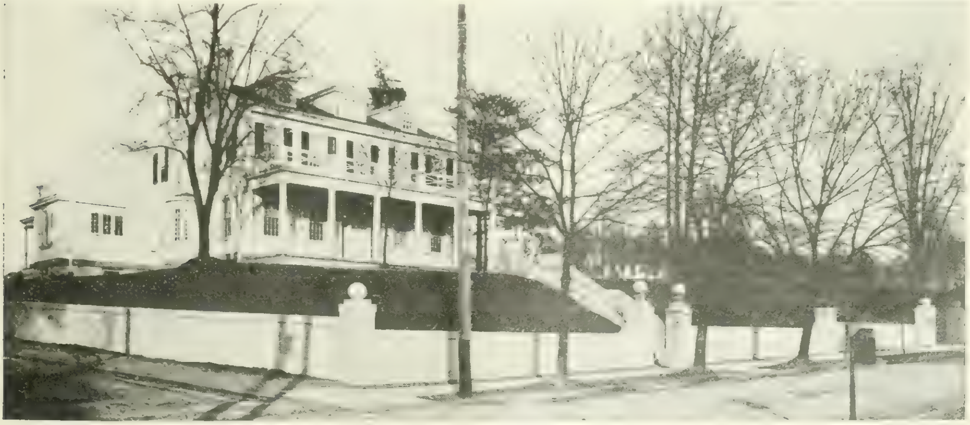
3. Supervision on the part of the city, at the expense of the owner, would be unfair unless that supervision carried with it a degree of responsibility which, according to law, the city cannot assume.

4. The work of minute inspection in this city would require at times probably 50 competent men, and at other times not even half a dozen. To keep on the payroll, therefore, an adequate force of skilled men would impose a tremendous expense.

5. The unavoidable delay of city inspection would work a hardship on the owner or contractor, or both.

6. Owners would reasonably object to paying for the services of men of whose ability they had no knowledge and in whom, therefore, they could have no confidence.

7. The architects and engineers would reasonably question the wisdom



An Old House [illegible]

of inspection that carried no responsibility, and naturally resent dictation from an inspector of inferior ability. Further, such dictation might be exceedingly dangerous to the safety of the structure and might also lead to intolerable conditions resulting from conflict of authority.

8. The entire plan of city inspection without responsibility would be a most prolific source of expense and annoyance.

Finally, we believe that the results which the Chief Inspector of Buildings wisely desires will best be secured by modifications we herewith submit for the consideration of your honorable body.

The amendments to the building ordinance recommended to the Council are as follows:

Strike out the old section 175 entirely and substitute the following:

Section 175. Before a permit can be obtained to erect any reinforced concrete structure, the applicant for such permit shall file with the Board of Public Works complete drawings, specifications and details, and schedules of all loads for all columns, beams, joists and girders, showing the size and position of all reinforcing members. Said plans and specifications shall exhibit the approval and the signature of a licensed architect or a licensed engineer, and such architect or engineer shall be required to give said work his personal supervision and to employ an inspector satisfactory to the Board of Public Works, said inspector to be present at all times on the work while the concrete is being mixed or deposited.

Strike out entire paragraph 3 of Section 176 and substitute the following:

Paragraph 3, Sec. 176. Every test of cement to be used in plain concrete work shall be made by a qualified expert employed by the architect, engineer, owner or contractor, while every test of cement to be used in reinforced concrete work shall be made by a qualified expert employed by the architect or engineer. Said expert shall be satisfactory to the Board of Public Works and shall file with said board, in the office of the Chief Inspector of Buildings, a certified copy of all tests made by him. Such tests shall be paid for by the owner.

The following letter embodies the protest of Harrison Albright, a Los Angeles architect, against a proposed ordinance providing for detailed inspection by the city of concrete work:

It has been reported to me that there is under consideration an amendment to the building ordinance which will make it unlawful for any concrete work to be done hereafter on any reinforced concrete construction in the city except in the presence of an inspector from the city building department. I wish to call the attention of your honorable committee[1] to the following reasons which lead me to protest against the enactment of this law:

1. It is a well recognized fact among the architects and engineers of the city that competent inspectors for reinforced concrete work are scarce. I believe that the passage of this law would result in many incompetent and impractical men being placed on buildings where their acts would result in no benefit to either the owner or the public, but would add materially to the cost of the building.

2. The exigencies of construction work on large buildings make it impossible to foretell exactly when it will be necessary to have the concrete mixer in operation. To wait for the arrival of an inspector would entail a hardship upon the contractor which would be reflected upon the owner in the shape of increased cost of his building.

3. The building ordinances are intended to establish the minimum standard of quality in materials and workmanship. Even though the presence of a city inspector might guarantee that minimum to an owner, it would guarantee him nothing more, although he might be paying for work of a higher grade than that established by this minimum.

4. The owner would feel that since he is compelled to pay the salary of a city inspector on his building, he could not afford to include cost of superintendence in the architect's fee; although the inspection included under this ordinance would cover only concrete work. The hundreds of dimensions that appear in an architect's working drawings are not for the convenience of the contractor alone. Under proper inspection the building is constantly under check by the inspector for lines, levels and dimensions. This is one of a dozen vitally important functions of the architect's inspector not secured for the owner except by means of an inspector responsible to the architect.

5. The present rulings of the building department require drawings for a reinforced concrete building to be signed by an architect holding a State certificate. If he is competent to design, why is he not competent to superintend?

6. In the year 1912, over one-half of the Class A construction in Los Angeles was of reinforced concrete. In the last eight or nine years many millions of dollars have been expended on reinforced concrete work in the city. All this has been accomplished without the loss of a single life, or even a serious accident, until the recent accident at the Pioneer stables. It is a record for safety to workmen and the public that has not been equaled in that period by any other common type of construction in the city.

Finally, I wish to make the following personal statement: My work throughout the Southwest, which has been exclusively of reinforced concrete, has always been of a grade that would meet the requirements of the Los Angeles building ordinances; in many details it has been better. My inspectors are chosen for competence and reliability only. If they should be displaced by men who hold political positions, I would not know a moment's peace of mind thereafter.

I submit to your honorable committee that the history of the reinforced concrete industry in Los Angeles, the various discriminatory restrictions already imposed upon it by the city, the economical and efficient type of construction it offers to owners of property, and the manifest inability of this proposed law actually to secure better than what we have now attained, are all good and sufficient reasons to show that this proposed law will be of no benefit to owner or public, but will, instead, impose an additional tax upon improvements to property.

HARRISON ALBRIGHT.

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[1]The letter was addressed [illegible] the building commission.—EDITORS

One- and Two-Course Work In Concrete Paving

Discussing one-course and two-course concrete pouring, C. W. Boynton[1] said: "In some localities, due to available materials, two-course work is better and cheaper than single course. Such a condition exists where the coarse aggregate is not tough enough to resist traffic, and granite screenings, or a clean, sharp sand, can be obtained for the top course. Two-course work requires more careful handling and more experienced labor in its construction than one-course. The difficulty in bonding fresh concrete to partially hardened concrete is well known, and it is this feature that must be watched carefully in two-course work. The bottom course should consist of at least 5½" of well-made concrete. The aggregate should conform in general to that described for one-course work, but may consist of material of lower abrasive value. The top course, 1½" in thickness, should be composed of a 1:1½ cement and fine aggregate in which the aggregate is either granite chips from fine to ½" in size, or coarse sand well graded from fine to coarse, the largest particle of which will pass a ½-in. screen.

"An analysis of the material cost of one-course and two-course work will show that the difference is so very slight as to be doubtful of estimation. However close an approximation an estimate may be, it cannot be exact, and, therefore, it will readily be seen in the following formulas that the main consideration in choice of type of pavement must necessarily be dependent upon the materials available; and the type chosen will be that to which they are best adapted. This formula is based on Taylor and Thompson's Table of Proportion. Considering: C equal cost of cement per barrel, G equal cost of gravel per cubic yard, S equal cost of sand per cubic yard. Then, for one-course work of 1:2:3 mix, 7" thick, the material cost per sq. yd. of pavement is .325C plus .0975S plus .146G; while for two-course work, 7" thick, composed of 1:2½:5 base, and a 1:1½ top mortar, the material cost per sq. yd. of pavement is .342C plus .1045S plus .133G.

"The two formulas show the tendency to equalize the cost by small compensating differences in the several quantities and are given here to illustrate this point."

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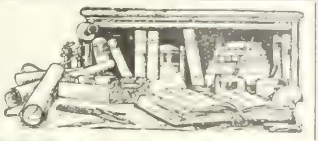
[1]Insp. Eng., Universal Portland Cement Co., Chicago, in a paper before Am. Soc. Eng. Con.

Information and Consultation



The Questions and Discussions in this Department are of interest and real value. Speaking for our questioners, we earnestly ask readers to discuss the questions submitted. For men in field and office, let this be a real consultation section, an exchange of ideas, among those who have, and those who have not, solved some of the problems of structural concrete. Questions and Discussions are cordially invited.

288. Wrapping I-Beams

"What is the best way of wrapping I-beam with wire or wire mesh to prevent the concrete below the bottom flange from cracking and dropping off?"

288. Discussion by D. H. Hayden*

In the Feb., 1913, issue, several efficient methods of holding concrete to steel soffits are described. Judging from the qualifications which are added, it is apparent that the discussion recognizes the important part borne by the workmen who install such work.

Several years ago the technical papers discussed at length the importance of protecting steel soffits, and various tests demonstrated the necessity of more than metal lath and plaster protection if a fireproof result was to be obtained. In an effort to get 12 stories in 120′ above the curb, Boston feels that 1″ of concrete or tile is good fireproofing on soffits, but other cities generally require 2″ of protection on the beams and 3″ on girders.

The insurance companies have in the past treated tile or concrete with equal favor, but experience shows that tile is no better than concrete even though the tile be free from kiln cracks, and be given a full mortar joint between all parts of adjoining tiles as well as between the tile and the steel which supports it. Such a result has been found as difficult to obtain as a proper method of holding concrete to soffits. Indeed, many conservative engineers claim that it has never been possible properly to protect a steel soffit commercially, and have therefore given up trying. Subway construction is an example of this case.

To the layman the fact that a recent fire in one of the new hotels in New York lasted for about half an hour without doing damage to the structure demonstrated that the building was fireproof. To the expert, however, this same fire proved conclusively that concentrations of inflammable materials will occur because of emergencies, or of permits granted in the rush of business. That the materials were of a nature to be quickly consumed, and thus avoid a prolonged fire, was a very fortunate coincidence, and one on which no owner could or should depend in general, for all insurance practice points to a very different outcome from such a concentration as occurred in this instance.

Hence, the use of proper support for materials protecting steel soffits is quite as important a question as any that confronts the architect or engineer. The framers of the building laws and the fire underwriters specify that soffits shall be protected because they *know* it is necessary. Nevertheless as no efficient commercial method of doing it has been discovered (since no protection can be regarded as efficient which has not stood a vigorous hammer test, and bad parts broken out and replaced), the inspection has been so superficial that contractors have come to treat this part of the work as if it were mere decoration. In general we are complying with one of the most important requirements of the law, simply because it is *law*, and because of the difficulties attending the problem have lost sight of the *spirit* of the law, which is to protect both life and property. The average architect seems to be more concerned about the disfigurement caused by the cracks which, when the building is finished, appear about 2 in. up on the sides of the beams than about the fact that these same cracks show that his building is not fireproof, and that the entire soffit may drop and injure some one.

Hammer tests have shown the writer that a surprising amount of fireproofing which was to all appearances everything to be desired, was in reality the merest sham. The concrete in the middle of the soffits for a width approximately 3 ins. less than the steel to which it was applied was actually nothing but a mere shell, formed by the neat cement and fine particles of sand that were washed down when the concrete in the haunches was tamped, and in many places the work was not more than ¼″ to ⅜″ thick.

The protection of steel soffits is of primary importance; the cost of the concrete or tile is a waste of good money and the result is merely dangerous decoration, unless properly applied.

Steel soffits should be protected by either cement mortar, concrete or tile, but never by less than 2″ of material exclusive of plaster. Individual soffits from 10″ to 20″ inclusive, should be protected by not less than 3″ of concrete. Soffits above 20″ in width should have 4″ of material on them. Cement mortar or concrete soffits are preferable to tile because it is possible to subject them to a vigorous examination by means of a hammer test and if proper reinforcing is used any parts found defective can be broken out and the work repaired so as to give a thoroughly strong and fireproof result. The reinforcing should be rigidly attached to the steel and should be of a continuous nature, so as to give lateral support, with reinforcing members occurring at not more than 8-in. intervals, and so arranged that the maximum offset will occur under the extreme edges of the flange (even beyond, if possible) and have a uniform and definite relation to the face of the flange. The reinforcing should also pass across the flange at similar intervals and position so as to provide ample means for repairing defective parts. The ends of the reinforcement that rest on top of the flange should have enough offset or enlargement to form an anchorage sufficient to develop their tensile strength. Haunches above 12″ in depth should have vertical reinforcement spaced at not more than 8-in. intervals. Haunches over 30″ in depth should have a similar vertical reinforcement, but should have at least three ⅜-in. round rods extending longitudinally and passing in basket-weave fashion between the vertical members and wired occasionally to the vertical members so as to prevent displacement. The center of the web should have holes not more than 3′ apart and the center bar should be drawn slightly toward the web through these holes and secured in this position. This specification should be followed for all soffits regardless of the system of floor construction. However, if tile soffits are to be used the tiles that protect the soffits and haunches should each be securely fastened to the steel by means of metal ties of not less than No. 12 ga. and so formed as to be capable of developing their tensile strength.

I have discussed this matter at some length because I cannot help feeling that if a concentration of inflammable materials in one of our high buildings should result in a fire of several hours' duration, the result might be so appalling as rather to shake the generally accepted confidence in the security of such construction.

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*Mitchell, Tappen Co., N. Y. C.

288. Discussion by T. A. O'Rourke*

The editorial discussion[1] of how to apply concrete to the bottom of steel beams seems to describe the ordinary way of doing that kind of work. I merely want to say that even if it is efficient, there must be something wrong about it. I am a plasterer and not a fireproofer. My complaint is that in many cases the plasterer gets blamed for the cracks that disfigure the sides of the finished beams, when, if I am not mistaken, the difficulty is with the fireproofing.

* * *

290. Washing Concrete Materials

"Is there any quick and easy way to wash gravel for concrete work?"

290. Discussion by Irvin Wymore†

Where a batch mixer is on the job, Mr. Weiland's plan[2] is probably the best. I have washed sand and gravel by nailing together the edges of two pieces of plank, 2"x12" and 16' or 20' long, making a V-shaped trough. Set this on an incline of 1-ft. fall in 4-ft. run, with the lower end high enough to run under it a wheelbarrow. It is best to have it on a hillside so that the upper end will not be too high for a man to shovel the gravel into the trough. Turn the water in at the upper end and it will carry sand and gravel into the wheel-barrow. Unless the gravel is quite dirty I find that the water from a 1-in. pipe under 30 lbs. to 50 lbs. pressure will wash as much sand or gravel as one man can shovel.

When the wheelbarrow is full of aggregate it should be taken from under the end of the trough and turned far enough over on the side to drain out most of the water. If filled too full, the aggregate will run out with the water.

* * *

300. Books on Lime Manufacture

"What books are there available on lime kiln construction and lime burning?"

300. Discussion by Richard K. Meade‡

There is not an accepted text-book on the subject of lime kiln construction and lime burning. About the best thing I know of is a bulletin published by the Ohio Geological Survey[3] entitled "Lime Industry of Ohio." This book is by Prof. A. V. Bleininger, and I think it is sold for about a dollar.

There is another book which has been issued by the Nat'l Lime Manfrs. Assn., consisting of papers read before this society. This contains considerable information on lime burning. It costs about $2.00 and may be obtained from Wm. W. Carson, Pres. Nat'l. Lime Manfrs. Asso., Riverton, Va.

These two books are about the only thing which I can suggest that contain much practical information on the subject of lime burning.

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300. Editorial Discussion

At Mr. Meade's suggestion, the matter was referred to the Geological Survey of Ohio, and J. A. Bownocker, State Geologist, refers us to Bulletins 3, 4 and 5 which are listed and briefly abstracted as follows:

Bulletin 3. Manufacture of Hydraulic Cement. (391 pages; 1904.) By A. V. Bleininger.

General considerations of hydraulic cements. Raw materials of the cement industry. Analysis and testing of the raw materials. Manufacture of pozzuolana and natural cements. On the nature of Portland cement. The compounding of Portland cement mixtures. Mining and preparation of the raw materials. The burning of Portland cement. The grinding of the clinker and general arrangements of plants. The properties of Portland cement and the testing of cement. With 81 illustrations. 75 cts.

Bulletin 4[4]. The Lime Resources and the Lime Industry in Ohio. 361 pages; 1906.) By Edward Orton, Jr., and Samuel V. Peppel.

The occurrence, extent and economic classification of the limestones of Ohio. Methods employed in sampling and testing limestones. The composition of the limestones of Ohio, with special reference to their fitness for Portland cement manufacture, considered by counties. The composition, physical character, and uses of the limestones of Ohio, considered by geological formations. The uses of limestones of Ohio. Technology of the lime industry. With 53 illustrations.

Bulletin 5. The Manufacture of Artificial Sandstone or Sand-Lime Brick. (79 pages; 1905.) By Samuel V. Peppel.

History and description of the industry. The raw materials, their impurities and their preparation. The pressing and hardening, testing, properties of the product. Mechanical equipment for manufacture, processes and patents. With 8 illustrations. Price (Bulletins 4 and 5 conjointly), 45 cts.

* * *

302. Concrete Top Finish in Compression

"In designing a reinforced concrete floor, under what conditions of construction would the ¾-in. or 1-in. cement mortar top finish be figured as an integral part of the slab and used in compression?"

302. Discussion by Sanford E. Thompson.*

I will say that a mortar surface on a reinforced concrete floor can be figured as an integral part of the slab and assumed to take full compression when it is laid at the same time as the remainder of the floor, that is, when the wearing surface is placed before the concrete in the rest of the slab has begun to harden. In order to accomplish this in practice, it is necessary to make the requirement that the surface shall be placed within 30 min. of the remainder of the concrete. It is possible by taking great precautions to bond a wearing surface to a concrete slab after the concrete in the slab has set. This requires special treatment, including thorough cleaning and soaking of the old concrete, providing a bond layer of neat cement mortar, and placing the surface before this neat cement has begun to harden. In view, however, of the danger of occasional poor joints between the two layers even with considerable care, I do not consider it safe to include the thickness of the wearing surface when figuring the thickness of the slab to use in design, unless it is laid at the same time as the rest of the concrete.

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302. Discussion by Birtram W. Ranson.*

In regard to the conditions under which the top cement finish of a reinforced concrete slab could be figured as an integral part of the slab and used in compression, I should say that this practice is only justifiable when the finish is put on the rough concrete base before the base has set. The cost of laying a finish in this way is of course, somewhat greater than it would be if applied after the concrete base has set, but this extra cost is more than offset by the saving in material which amounts practically to the entire thickness of the cement finish itself, because if the finfiish is put on after the base has set, it cannot be figured for strength and is only so much extra material and so much extra dead load for which the construction must be figured.

There is also an advantage in applying the top finish before the base has set in that the extreme fibre stress can be increased about 25% over what it would be for the ordinary concrete mix. This extreme fibre compression can be readily laid out graphically by laying off a triangle, the vertex *A* of which will fall on the neutral axis of the slab and the distance *AC* will represent the depth from the neutral axis of the slab to the top of the cement finish. Then by drawa line *EB* parallel to *DC* and a distance down *CB* in the proportion of the whole depth *AC* that the thickness of the cement finish is to the height of the triangle, the line so drawn *EB* can be allowed to represent the maximum allowable extreme fibre stress on the ordinary concrete, and the base of the triangle *DC* can be computed on this ratio to represent the allowable extreme fibre stress on the cement finish, provided of course that this extreme fibre stress represented by *DC* is not in excess of the maximum allowable extra fibre stress for the cement finish. This is a point which is seldom considered but from a standpoint of economical designing is well to bear in mind.

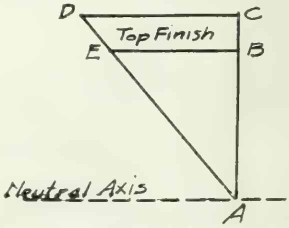

Diagram Showing Fibre Stress in Top Finish

302. Discussion by John T. Simpson†

It has been the writer's practice, where cement top finish was installed simultaneously with the reinforced concrete work upon which it rested, to figure the entire thickness of the cement mortar in compression in connection with the supporting structure, giving it the same compression value in each case as used on the balance of the work. In no case, however, where this top finish has been installed more than one or two days after the concrete base was put in place, have I considered it advisable to consider any part of it in compression as a load carrying element.

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*Plastering Contractor, N. Y. C.

[1] P. 75, Feb., 1913, issue

†Concrete Constructor, Ada, Okla.

[2] Discussed under this item, p. 76, Feb., 1913, issue

‡Consulting Engineer, Baltimore

[3] Columbus, O.

[4] Bulletins 4 and 5 are bound in one volume

*Cons. Engr., Newton Highlands, Mass.

*Minneapolis, Minn.

†Cons. Eng., Newark, N. J.

I have conducted numerous tests as to the adhesive quality of cement finish laid upon old concrete varying in age from three days to three months and have found that while in many cases the adhesion is apparently satisfactory and for a wearing surface would probably answer, yet in no case was there trouble experienced in prying off the top finish in sheets, showing that there was a clearly defined shearing plane between the old and the new work. For that reason I would hesitate to put any compressive stress on cement finish unless it had been installed simultaneously with the base upon which it rests.

302. Discussion by E. S. Martin†

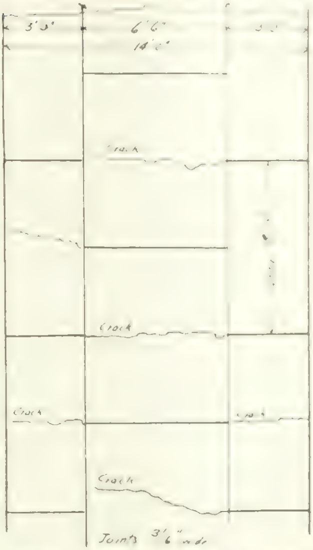
The criterion of the effectiveness of a cement mortar floor finish in affording additional strength to the rough concrete slab is the character of the bond between this top finish and the rough slab. If this finish coat is not less than 1" thick and preferably 1¼" or 1½" thick, and if it is put down comparatively dry and plastic after the rough slab has been thoroughly cleaned by removing laitance with a wire brush, the slab washed off entirely free from loose particles and well soaked down with water for at least six hours before applying the finish, this finish will bond with the rough slab sufficiently well to be actually an efficient part of it and increase the stiffness of the floor to the same extent as if the rough slab were made thicker by the amount of the top finish. When the workman cannot be depended upon to use this care in putting down finish, the bond is correspondingly uncertain and the value of the finish coat as an element of strength must be correspondingly reduced and neglected in designing. In the eastern section of the country it is quite common for the contractor or construction engineer to figure on the cement finish in his design.

Some of the large corporations in their work are inserting a layer of cinder concrete between the finish coat and the rough slab in order to guard against carelessness in workmanship and secure a uniform condition. This, also, allows future removal of the floor finish and substitution of wood surface if the owner sees fit to make this change in after years. With this method of placing floor finish of course it is not counted on for strength.

* * *

292. Cracks in Concrete Sidewalk

"I am enclosing herewith a sketch showing the jointing plan of a granitoid walk, 14 ft. wide, which I built lately. When the architect showed me this plan, I told him that these joints would crack through the adjoining block, as shown on sketch. He laughed at me. Nevertheless, they did crack through. I have noticed this to happen almost every time. Is it caused by expansion or something else?"



Sketch Showing Arrangement of Blocks in Sidewalk

292. Discussion by J. R. Zeiser*

Judging from the nature of cracks as shown in the above sketch I would say that the failure was due to a separation of the slabs at the joints and to an improper proportioning and placing of these joints.

In successful sidewalk construction much depends on perfect separation of the work into slabs. These separations should extend clear through to the bottom of concrete and should have true perpendicular walls, free from ragged edges. If left otherwise, and one slab should settle a trifle more than the one adjoining it, they are liable to adhere, thus throwing all the weight onto one slab and causing either one or both to break. Transverse joints should be from 3/16" to ¼" wide and be left open to allow for expansion.

In the work referred to, transverse joints are too far apart and better results would have been obtained had they been spaced approximately 6 ft. apart instead of 8 ft. as shown.

The indications are that this work was laid in one continuous sheet and then either imperfectly cut with a knife or a similar tool, or was only marked through top coat.

The better method would have been to build this walk in three longitudinal sections, using steel dividing blades to form transverse joints, and withdrawing these before the concrete had become set. This would have provided clean, perfect expansion joints, and insured separation clear through to bottom of concrete.

These steel blades are provided with hangers at either end which extend over the side rail and serve the double purpose of holding the side-rails in alignment, thus dispensing with the use of pegs driven in the ground, and also forming the necessary expansion joints.

With forms of this nature much less time is consumed than where rails are staked to place and a knife or similar apparatus is used to cut expansion joints—a practice which is fast becoming obsolete.

The blades referred to can be readily obtained and can be had either to be used in connection with wood side rails or complete forms can be obtained, including steel side rails slotted at intervals of 1' to receive hangers of dividing blades, with dividing blades equipped with automatic locking device, which reduces the cost of form setting and forming of expansion joints to such a small item that it is hardly worth figuring.

307. Light House Whitewash

"What is a good formula for light-house whitewash finish?"

307. Editorial Discussion.

This query was referred to the Light-House Bureau of the Dept. of Commerce and in reply the Bureau forwarded a circular dated Oct. 24, 1906, which embodies standard practice of the Light-House Bureau as to whitewash and cement-wash formulas. The following paragraphs are quoted from this circular:

Whitewash

The following recipe for whitewashing has been found by experience to answer on wood, brick, and stone[1], nearly as well as oil paint, and is much cheaper.

Recipe:—Slake ½ bu. of unslacked lime with boiling water, keeping it covered during the process. Strain it and add 1 peck of salt, dissolved in warm water; 3 lbs. of ground rice put in boiling water, and boiled to a thin paste; ½ lb. of powdered Spanish whiting, and 1 lb. clear glue, dissolved in warm water; mix these well together, and let the mixture stand for several days. Keep the wash thus prepared in a kettle or portable furnace, and when used put it on as hot as possible, with painter's or whitewash brushes.

Cement Wash

For Exteriors:—Take of fresh Rosendale cement[2] 3 parts, clean sand 1 part, and mix them thoroughly with fresh water. This will give a gray or granite color, dark or light, according to the color of the cement. If a brick color is desired, add enough Venetian red to the mixture to produce that color. The cement, sand, and coloring matter must be mixed together. If white is desired, the wall, when new, should receive two coats of cement wash and then whitewash. After the work has received the first coat, a single coat every three or four years will be sufficient.

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†Rep. C. A. P. Turner, N. Y. C.

*Berwick, Pa.

[1] Concrete surfaces also are included.—Editors

[2] One of the standard natural cements; probably any one of the standard natural or Portland cements should serve.—Editors

It is best to dampen the wall thoroughly with clean, fresh water, and follow immediately after with the cement wash. This course will prevent the bricks from absorbing the water from the wash too quickly, and will give time for the cement to set. Care must be taken to keep all the ingredients of the cement wash well stirred during the application of it.

The mixture must be made as thick as it will admit of to be conveniently put on with a whitewash brush.

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309. Concrete Bridges to Withstand Flood, and Their Comparative Cost

The flood which occurred here recently has demonstrated the fact that steel bridge construction with stone abutments will not stand the test of permanency. Our tax payers consequently are beginning to feel the need of some education along the lines of bridge construction, as our county lost 30 bridges of steel construction during the recent floods.

"I have been asked to furnish some reliable data on this subject for the benefit of some of our large tax payers. Having this task on my hands, would you kindly furnish me with facts in regard to the comparative cost of reinforced concrete bridge construction as against steel construction with stone abutments."

[This is a query coming from the flood district of Ohio. It was referred to bridge engineers; and the following is the first discussion that has come in—Editors.]

309. Discussion by W. H. Adams*

It is a little difficult to give exact information without data concerning the particular bridge under discussion as the cost of concrete bridges is affected by many things which would not enter into the cost of steel bridges. For instance, it is often possible to obtain gravel and sand on the site of the bridge. These would very much cheapen the concrete bridge while they would not of course change the cost of a steel bridge.

For a general discussion perhaps the following notes may be of interest: Three types of bridges may be considered as standard for highway use; the steel bridge with wooden floors, using either steel trusses or plate girders or even I-beams for the structural portions; steel bridges with concrete floors, and all-concrete bridges. So far as the abutments are concerned the cost of concrete per cu. yd. can be compared very readily on the ground with the cost of the stone per cu. yd. There is little advantage in a concrete abutment for a steel bridge unless the cu. yd. cost is less than that for stone masonry, but in the case of a concrete bridge the abutments, piers and bridge are all one piece and the abutments must necessarily be of the same material. This, of course, affords very greatly increased stability in the case of floods. It is very necessary, however, that a concrete bridge particularly should be placed high enough so that no probable high water will reach it. This is because the concrete bridge being more massive than the steel bridge, cuts down the water-way above normal high water line and if the water should rise much above what would ordinarily be the underside of the concrete bridge, a scouring action would rapidly begin on the piers unless indeed they were upon rock foundation. This scouring action was no doubt the cause of the wreck of the Meridian St. bridge, Indianapolis, in the late floods. On the other hand such high water would have entirely carried away the steel superstructure, although usually leaving the abutments very little injured.

If a concrete bridge is properly built and so designed as to afford ample water-way, it is a practically permanent structure. There is no annual charge for painting or depreciation. Concrete structures built 2,000 years ago are standing and in serviceable condition today and there is no reason to suppose that a well built concrete bridge will be anything but permanent. The life of a steel bridge is not over 50 years and there are many instances in which the life has been much less than this.

In addition to this depreciation, the annual cost for painting a steel bridge with wooden floors is from 2% to 2½% of the first cost. The annual cost of renewing wood floors of such a bridge is from 2½% to 6% of the first cost. If instead of wooden floors, concrete floors are laid, as is quite usual in many Ohio bridges, the cost of the structural steel would be increased owing to the greater weight carried. The maintenance cost will be considerably lessened as there will be no renewal charges for the floor and the amount of exposed structural steel may be somewhat less, as it is frequently possible to embed a part of the structural steel in the concrete.

As to the comparative cost we can only give some notes on what has been done recently. The cost of steel fluctuates very rapidly, much more so than the cost of concrete materials, and a comparison that might be just today could easily be far out of the way within three months.

In the past year we have designed a series of bridges for an interurban railway running out of Houston, Tex. Previously these bridges had been designed and bids taken on structural steel with concrete abutments. In every case the concrete bridges cost less than the steel bridges for the same crossing, the difference being on the average about 15%. While these bridges were for heavy interurban traffic and are not highway bridges, the difference in cost should be relatively the same for any type of bridge. These bridges were designed for very heavy loading, as heavy as would be used on steam railroads.

Of course on long spans, say 100 ft. or above, and in fact probably from 75 ft. up, a single span of concrete would usually cost more than a single span in structural steel, but there is frequently no good reason why an intermediate pier cannot be introduced, provided the total water-way area is not diminished. This is not so generally true regarding steel bridges, and is, we believe, one of the reasons why so many bridges of 100 ft. to 150 ft. span are to be found crossing small unnavigable streams.

Each separate problem should be taken up by an experienced engineer and it is only after an engineer's investigation that the most economical spans can be determined.

* * *

310. Bonding Old and New Concrete

"What is the best way to treat a concrete surface to secure the most effective bond between old and new concrete?"

310. Editorial Discussion

Cracks appearing on wall surfaces follow in a great many instances, lines where one day's work stopped, and mark the junction of new and old concrete work. In the Proceedings of the Inst. of Civ. Engrs., London, Hector St. George Robinson reports a series of tests conducted to settle a dispute as to the responsibility of a contractor for the efficiency of joints in a reinforced concrete building.

In view of the great difficulty experienced in obtaining reasonably uniform results when fairly large concrete specimens were tested in direct tension, it was decided to test prisms by cross-bending. The apparatus required to carry out this type of test is of a simple design, and it was thus possible to make the tests under natural conditions in the field.

In connection with bending tests, it is important, the author states, to keep in view the fact that the calculated stress in tension at the extreme edge of a bar of square or rectangular cross-section is much higher than the value obtained in direct tension. In the present case, the tensional strength or modulus of rupture is used for comparative purposes only.

For the purpose of the experiments, concrete prisms 30" long and 4" square were made in timber molds lined with zinc. The prisms were tested as simple cantilevers, being fixed at one end and loaded at the other as shown diagramatically in the accompanying illustration. The distance from the joint to the point of application of the load was 20", and in arriving at the tensile stress at the joint the dead weight of the portion of the prism broken off was included. In testing, the prisms were placed so that the top or tension side was the underside during molding. The concrete was of uniform composition throughout, made in the proportion of 2 cu. ft. of crushed Thames ballast, 1 cu. ft. of clean Thames sand and 45 lb. of Portland cement—practically a 1:2:4 mixture by volume. The aggregate was mostly crushed flint pebbles, all passing a ¾-in. mesh sieve and being retained

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*Adams and Cummins, Cons. Engrs., Detroit

TABLE SHOWING CALCULATED TENSION AT EXTREME EDGE OF PRISM, [illegible]

The tension is given in lbs. per sq. in. With *s* the tensile stress in the [illegible], *M* as the bending moment in in. lbs., and *z* the modulus of section, $s = M/z$

Series A		Series B		Series C		Series D		[illegible]	
Test No.	Solid Prisms	Test No.	Face Wetted only	Test No.	Face Roughened and Wetted	Test No.	Face Roughened and Grouted	[illegible]	Face Treated [illegible]
A 1	302	B 1	131	C 1	194	D 1	315	[illegible]	[illegible]
A 2	362	B 2	78	C 2	179	D 2	—	E 2	[illegible]
A 3	289	B 3	139	C 3	205	D 3	272	E 3	[illegible]
A 4	—	B 4	110	C 4	142	D 4	280	E 4	[illegible]
A 5	340	B 5	—	C 5	165	D 5	248	[illegible]	[illegible]
A 6	352	B 6	172	C 6	234	D 6	—	[illegible]	[illegible]
Average	329	—	126	—	186	—	281.2		[illegible]
Efficiency	100 %	—	38.3 %	—	56.2 %	—	85.5 %	—	[illegible]

on a ¼-in. mesh sieve, the average percentage of voids being 34. The sand was screened from the normal Thames ballast, the grains being ¼-in. and less, and the voids in this case being 31.5%. The cement conformed to the British Standard Specification and was bought in the open market. Its average tensile strength per sq. in. was as follows:—

Neat at 1 day ....243 lbs.
Neat at 7 days ....625 lbs.
Neat at 2 months ......768 lbs.

It set initially in 1 hr. 25 min., the final setting time being 4 hrs, 30 min. In mixing the concrete, 10% of water was used, based on the total weight of the dry materials. Five sets of prisms were made and the conditions as to mixing and storing were identical.

To arrive at a basis for comparison, a set of six prisms (referred to as series *A*) was made without joints, these specimens being molded and tested when 28 days old. In the remainder, division boards of roughly-sawn spruce were fixed in the molds 8" from one end and first portion of the concrete was placed and well rammed. These short lengths were allowed to harden for 7 days, after which the face against which the new concrete was to be placed was prepared and the prisms completed, care being taken to ram the new material well against the old face. The finished prisms were then allowed to harden for 28 days, after which they were tested.

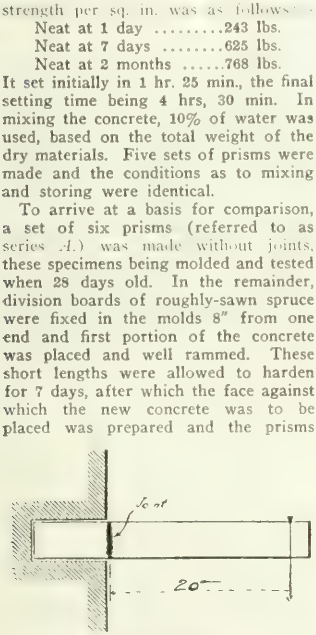

DIAGRAM SHOWING ARRAGEMENT OF TEST PRISMS

Four distinct types of joint were investigated. In series *B* the faces of the 7-day old concrete were merely washed and well wetted prior to the imposition of the new material. As these faces had been molded against a somewhat rough soft-wood board they were fairly open and coarse, and the somewhat high efficiency obtained with these joints is due to this roughness. The face in series *C* were roughened with a chisel, all the loose material cleaned away and the surface thoroughly wetted. In series *D* the faces were prepared first as in series *C*, and were then washed over several times with a thick wash of semi-liquid neat cement grout, the new concrete being immediately applied. In the last series, *F*, the faces were thoroughly cleansed with water and treated with hydrochloric acid. After the acid had removed the cement to a depth sufficient to expose the aggregate and thus leave a very rough face, all traces of the acid were removed with stiff brushes and water and new concrete was then applied.

The results of the tests are tabulated in teh accompanying table. Prisms A_4 and B_5 were defective while prisms D_2 and D_6 broke outside the joint, therefore these cases have not been included in the table. All the other specimens broke wholly or partly at the joints. The average efficiency of the various joints in the table is given in relation to the strength of the unjointed prisms.

While these tests are somewhat limited in scope, it is evident that there is considerable difference in the strength of the various joints. The value of roughening and grouting is clearly apparent. The joints treated with acid show a high efficiency, but the trouble and care necessary for the successful use of acid, especially where an aggregate of a porous nature is used, is opposed to its adoption in actual practice.

* * *

308. Creosote Stains Concrete

"We have constructed a two-story reinforced concrete building with a 4-in. x12-in flue, cast in one of the outside walls in a projecting pilaster. We did not either waterproof or plaster this flue on the inside and now we find that the smoke from a small wood stove condenses and forms a creosote which has saturated the walls on both sides for several feet around the chimney hole. It has also broken through and stained the outside wall. Is there any way of preventing this discoloration?"

308. EDITORIAL DISCUSSION

Further information was requested covering the details of this matter. The following letter gives more information.

"The aggregate used was bank sand and gravel, using about 43% sand to 57% gravel. All the gravel would have passed through a 1-in. ring. The concrete was mixed 1 part of cement to 4 parts of the sand and gravel, and was poured wet. The walls are reinforced with twisted steel bars. The supposition is that the smoke condenses in the chimney and forms this creosote-like liquid. It runs in damp, foggy or rainy weather only. The flue is so protected that the rain cannot enter it. The discoloration is worse at the base of the flue although it shows for several feet on the exterior of the building above the point where the stove pipe enters. The wall is plastered inside with ordinary hard plaster, a float finish. The outside is finished with a cement plaster to which has been added a little lime. So far this creosote has not apparently affected the quality of the concrete. It is simply a very unsightly wall."

308. DISCUSSION BY C. W. BOYNTON*

Regarding the formation of creosote on the concrete of a small chimney we suggest the following as a remedy:

Insert an oval pipe of galvanized iron in the flue, connecting it with the pipe leading from the wood stove in the building. This would prevent any more creosote reaching the concrete; and since the oval pipe would leave spaces at the corners of the flue, the new lining would be partially insulated and there would be a considerable reduction in the condensation—if it were not stopped altogether. Of course the galvanized iron pipe should be inspected from time to time to prevent possible trouble through rusting.

We do not see any way to remove the discoloration on the surface of the concrete wall except by applying another coat of stucco to the exterior or by covering the surface with some form of concrete paint, of which there are a number on the market.

Paints For Concrete

The following letter has recently come in from Andre L. Casset, 15 Ave. d'Allemagne, Paris, France, a CONCRETE-CEMENT AGE reader. The letter expresses in a simple way the elemental reactions in a paint which is being successfully used on concrete surfaces. The letter follows:

"I believe that your readers would be glad to know a simple and effective process of painting over concrete surfaces. The reason that oil paint does not stand well on concrete surfaces is that the oil is saponified by the free lime of the cement. We have found it good practice to put on a coat of cheap metallic sulphate solution, say zinc sulphate, about a 1:5 solution. This produces by the following reaction a coat of plaster and zinc sulphate quite harmless to oil over the cement surface,

$$CaO + SO_4Zn = So_4Ca + ZnO."$$

Plant of the Granite City Lime and Cement Co., near East St. Louis, Ill., recently destroyed by fire, is being rebuilt. It was built of brick.

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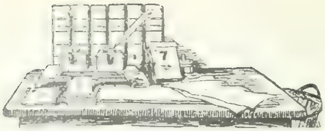
*Inspecting Eng. Universal Portland Cement Co., Chicago

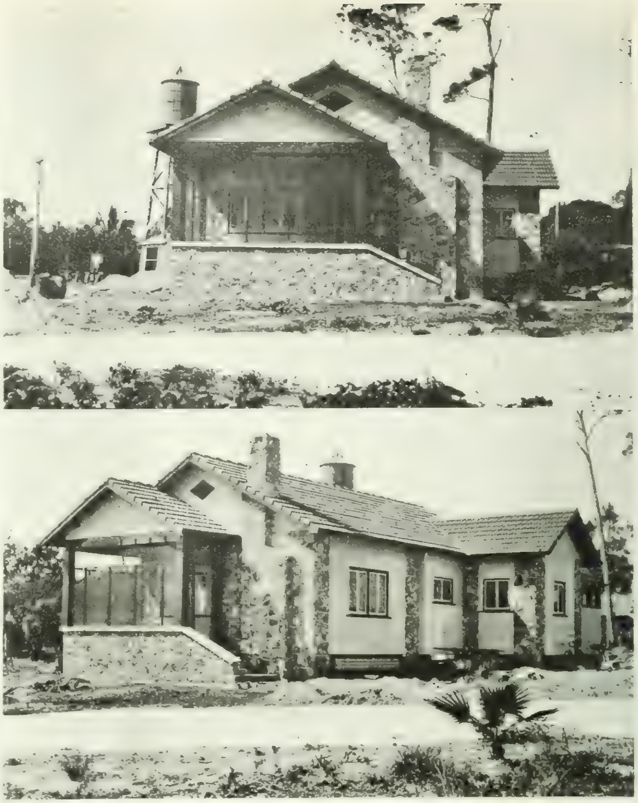


CORRESPONDENCE

House of Stucco and Lime Rock

The house shown in the illustrations was designed and built by William de Guiselle. It is constructed of a buff colored, native rock and concrete stucco. The pilasters are built of native rock artistically arranged. The main walls are of metal cup lath nailed to studding, 2″ x 6″, then plastered on both sides of metal lath until 1½″ thick with two coats of strong Portland cement mortar, then washed on the outside with a mixture of cement, lime, and clean white sand to bring about a uniform color and appearance that cannot be given with the float. The house has a red clay tile roof and fireplace and chimney of the same native rock as the pilasters. This native rock is a limestone formation, and soft enough so it can be hewn with a hatchet. It is common in several colors, white, gray and buff. After it has been exposed to the weather for a time, it becomes very hard, has a resistance equal to any limestone, and is very beautiful. This house has five rooms, besides a bath room and a den, and was built at a cost of $2,500. It has maple floors and all best material used in the finish.

MRS. WM. DE GUISELLE.
Cocoanut Grove, Fla.



TWO VIEWS OF FLORIDA HOME BUILT OF LIMESTONE AND STUCCO ON METAL LATH FOR $2,500

* * *

Laitance in Sea-Water Concrete

[In a paper presented before the last convention of the N. A. C. U. (Pittsburgh, Dec., 1912), Rear-Admiral H. R. Stanford made some reference to a laitance formation found while repairs were under way. For further information, we were referred to the engineer in the Boston district. The following letter is in reply to our query.—Editors.]

With reference to the composition of the material found in the quay wall at the Boston Navy Yard while making repairs, some of the past records in the navy yard files have been looked up and the reports indicate that disintegration of the walls must have begun soon after the concrete was placed, because photographs taken early in 1903 show evidences of this disintegration. The failure of the concrete was almost entirely between the high and the low water mark. Below low water and above high water it was generally very good. The failure is believed to have been largely due to chemical action, though this is not proven at the present time. The concrete was placed quite dry, thus allowing the ingress of sea water. Other concrete which was deposited wet at about the same time does not show similar disintegration.

In the course of cutting away the old concrete in making repairs, layers of a white, putty-like substance sometimes several inches in thickness were found, and the substance seemed to have chemical activity for some time after being taken out. The workmen complained that it burned their hands.

Some of this material was analyzed by the general chemist employed by the navy yard, and a copy of his report follows.

R. E. BAKENHUS.

C. E., U. S. N.,
Public Works Officer.
U. S. Navy Yard,
Boston, Mass.

The report signed by A. L. Babbitt, chemist, follows:

A sample of cement deposit has been tested with the following results:

Moisture	13.66%
Insoluble residue	5.86%
Silica (SiO_2)	8.87%
Iron & Aluminum Oxides	4.38%
Lime (CaO)	31.11%
Magnesia (MgO)	5.35%
Sulphuric Anhydride (SO_3)	6.68%
Carbon Dioxide (CO_2)	9.63%
Salt & Undetermined	2.41%
Combined Water	12.05%

There has been a decided interaction between the magnesium sulphate of the sea water and the tricalcium silicate of the cement. Attention is called to the large percentage of magnesia, sulphuric anhydride, and carbon dioxide. The sulphuric acid is combined with the lime and can be extracted from the original sample by water to the extent of Lime (CaO) 6.75%, Sulphuric anhydride (SO_3) 4.91%. The magnesium left combines with the carbon dioxide of the air.

Analyses of Portland cement concrete (1:3:6) show that the active principle (the soluble silica, iron and alumina oxide, and lime) is about 25% of the whole. If this be true, multiplying the results of my analysis by 4 will give about the percentage of magnesia figured on in the cement alone. The cement had from 2% to 4% of magnesia originally, so that nearly 20% has been taken on from the sea water. This has combined to leave the cement in a more soluble condition.

* * *

Wanted—A Word

Every time when I specify a coating of cement and sand (what is usually called a "cement finish") for concrete floor or on a wall, I am at a loss for a proper name for such a coating or finish. What I am trying to get at is a name for the mixture of cement and sand that will correctly designate such a mixture. "Concrete" seems a good name to designate the mixture of cement, sand and gravel, and a word that would signify the combination of cement and sand would be very handy indeed. With this word one could say "concrete floors to be covered with ———(?) to thickness of 1", proportioned—1 cement to 3 sand;" or, "———(?) to have 2 coats of floor dressing," instead of saying "cement finish to have 2 coats of, etc."

If through your columns you can get some readers interested I will come along with some suggestions for a name.

A. Morgan Smith.

Concrete Architect,
Mt. Lebanon, Pa.

[What Mr. Smith asks for is a "use" definition, not a "material" definition. A mixture of cement and sand, to which water is added, is commonly known as "mortar," but this definition has to do with the mixture itself rather than the purpose for which it is applied. When *plastered* on *vertical fabric*, the cement-sand mortar is of course called "stucco," What is it called when it is *poured on a horizontal* or *applied* to a *vertical surface?*—The Editors.]

* * *

The Economy of Bulk Cement

The trend of the times is away from the old American wastefulness. Conservation of our resources has become a national policy, and it is the fashion among us concrete people to herald ourselves as the advance agents of conservation. Intelligent economy is like Charity, however, in that it should begin at home, and every concrete man should realize that, while he is undoubtedly doing a noble part in conserving our diminishing lumber supply, it will be more directly to his advantage if, at the same time, he will do his part towards the conservation of our labor supply also. It is seriously apparent that the demand for laborers is beginning to exceed the supply, and the time has come when every employer should give his thoughtful consideration to the problem of increasing the efficiency and output per man of the laborers that we are able to secure mechanical mixers and conveying machinery have done a great deal to increase the output per man of the laborers employed in concrete work, and to these agencies should now be added bulk cement The tube mills in the cement plant turn out bulk cement, and it is bulk cement that goes into the mixers on the job.

There are, of course, certain conditions which demand that the cement be put into some form of package in order that it may be properly handled, but in my estimation there are millions of barrels of cement used every year which could be handled from start to finish without ever having to go into a package, and we waste labor and money in putting that cement into sacks and then taking it out again.

When a carload of cement arrives on a job, the cement, whether sacked or in bulk, must first of all be unloaded from the car. We will assume that this is done in both cases by means of wheelbarrows. When a wheelbarrow load of cement gets to the mixer, seven things have to be done to each sack. These are the seven things that the men on the job do.

1. Untie the sack.
2. Lift the untied sack to the mixer hopper.
3. Hold sack in place while the cement runs out.
4. Shake the sack to avoid losing cement.
5. Lay the sack away carefully (or take a chance of having it destroyed).
6. Take the empty sacks away.
7. Shake, count, bundle and ship the empty sacks.

The average carload of cement contains about 700 sacks. To handle a carload of sacked cement calls for about 5,000 separate and unnecessary operations.

Now let us consider the case of the wheelbarrow load of bulk cement. It arrives at the mixing platform and is dumped with one motion, and the wheelbarrow and the man running it get out of the way, and start for another load. The wheelbarrow load of bulk cement is emptied in the same time as the barrows of sand and stone. There is no prospect of five or six men with wheelbarrow loads of sand and stone lined up and waiting until all the unnecessary operations, which I have already described, can be performed on three or four sacks of cement. On the contrary, the work goes forward in a regular and orderly way. Incidentally, there is no man standing around by the mixer all day waiting for the sacks of cement to come up, so that he may untie them, and empty them into the mixer. It is obvious, therefore, that the use of bulk cement on a construction job must result in greater efficiency and a higher output of concrete per man employed. These conclusions are not purely theoretical. They have been verifiefid by practical experience.

The Nash-Dowdle Co. of Chicago found that when they were using bulk cement, they could cut one man and sometimes two men, off each mixing crew. They measured their cement in wheelbarrows and did not spend one cent on additional or special equipment.

In suggesting these comparisons, I have restricted myself to conditions where cement is used in the simplest and most elementary way. In concrete products factories, where proper equipment for handling and storing bulk cement may justly be considered a proper and money-making addition to the plant, conditions will be even more in favor of bulk cement. With properly designed equipment, machinery can be made to unload cars, warehouse the cement, and deliver it as required to the mixer.

Conservation of capital is another object that may be attained by the use of bulk cement. A dollar that is invested in an unwise way is not doing its fair day's work. If a contractor owns that dollar he is entitled to a direct benefit from it. Otherwise he might as well not own it. If he has hired that dollar from a bank, and the dollar is not actually earning money for him, the interest that he is paying for the use of it is a dead loss. The average carload of cement contains about 700 sacks. That is to say, for every carload of cement in cloth sacks that a man buys he has to invest $70; this $70 remains invested in those sacks, whether full or empty, until they have been returned to the cement company and payment received for them. Any cement user can tell from his own records how much money he has tied up in sacks at any particular time, and then, if the work on which he is engaged is of such a nature that it could be done with bulk cement, he will know how many dollars are loafing on the job when they might be engaged in doing something that is worth while.

Gordon Wilson.

Ast. Sec., Universal Portland Cement Co., Chicago.

* * *

Painting Structural Steel

In heavy structural steel work, especially where the finished structure is to be exposed to the elements, it is absolutely necessary to have the members protected from moisture, gases of various natures, etc., in some way, and the cheapest and quickest way to apply that protection is by painting. This is usually done in three coats, one when it is fabricated in the shop, one directly after it has been erected in the field, and then a finish coat on top of that. These coats are of different colors, in order that the inspector may easily determine whether or not the coat has been applied at all, and if it has been applied properly. It is a generally accepted fact that a pure linseed oil is the best shop coat, and the other two coats vary in the opinions of the engineers in charge of the work. However, any pure pigment and pure linseed oil will give the best results, the greatest difficulty being in getting the former.

A good cement paint will answer the purpose excellently or a thin coating of cement grout will do as well. The cement or concrete which is applied to any structural steel, however, in order that it may absolutely prevent rusting should be of a very dense nature, with just as few voids and air-pockets as it is possible to obtain. It is our opinion that where the structure is to be encased in concrete, it is better not to paint the steel after the first shop coat, and before the concrete is applied, to clean it thoroughly, and use a metal mesh passed around the member, and as close to it as is possible, to hold the concrete to it. The concrete should not be composed of large aggregate, and should have a preponderance of mortar, and should be poured very wet.

In structural steel the concrete is not placed around the members to carry any of the load, but to prevent deterioration and to offer fire protection. Thus the question of bond is not important at all, and the shop coat of linseed oil should be used to prevent the members from rusting, until the concrete can be poured around them which makes the other coats unnecessary.

E. B. Murray.

Kansas City, Mo.

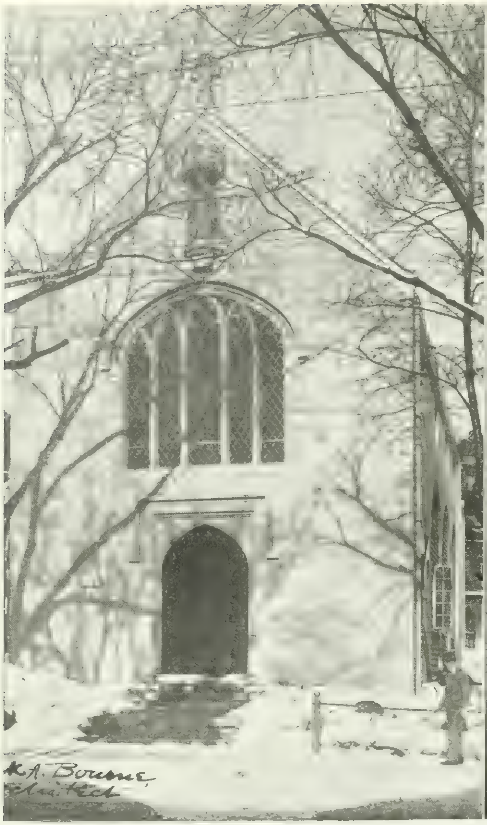


Fig. 1—St. Luke's Church, Chelsea, Mass.

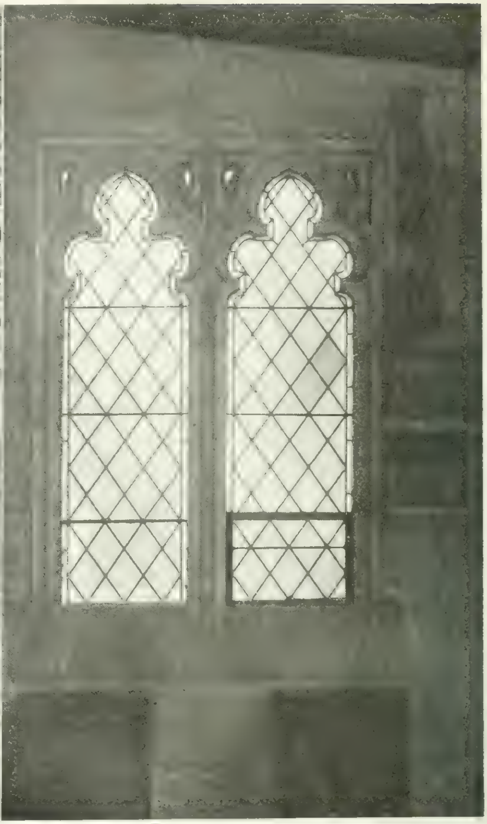


Fig. 2—Window Tracery of Concrete

The Development of Concrete Block

If possible I want to strengthen Oswald C. Hering's protest against any cast-iron imitation of rock-face in concrete block, and against too much cheapening of the product.[1]

On the other hand, as Mr. Hering states in his book, concrete block have a field, in construction, and they have been used recently by some of the best architects in America. I remember particularly another large residence besides the one illustrated. In this case the block were of plain face and the coursing was as carefully laid out as it would have been for any other stone work, and the whole workmanship was equal to any other good masonry construction.

It is to be regretted that the anxiety to get a cheap building material has resulted not in legitimate reduction of cost by standardizing the product and making the block in uniform sizes somewhat similar to the way brick are handled. The amount of deliberate scamping of material and attempted delivery of poor soft block has done much to prevent the growth of the use of an article that has certain advantages.

I have used in my own practice large plain face block—so large that they might be called by another name, in scale similar to what is generally used in lime stone ashlar, say, 32"x12"x12". These give a good exterior finish merely by their size, and in inexpensive churches by using the inside face unfinished for the church wall, and by using a concrete stone window trim, an exceedingly effective church interior is obtained at a moderate expense.

There is a simplicity and solidity in this construction that add to this effect, and with the use of leaded glass in the windows, there is absolutely nothing to burn. All that is necessary is to give the material the same honest treatment that is now given to brick work; much more dishonesty is likely to give all use of concrete in block such

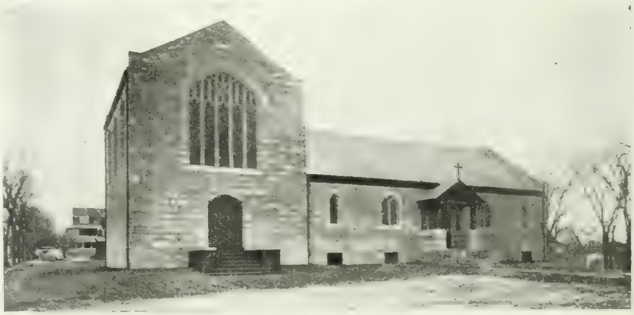


Fig. 3—Church of Epiphany Dorchester, Mass.

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[1] Feb., 1913, issue, p. 66 and p. 77

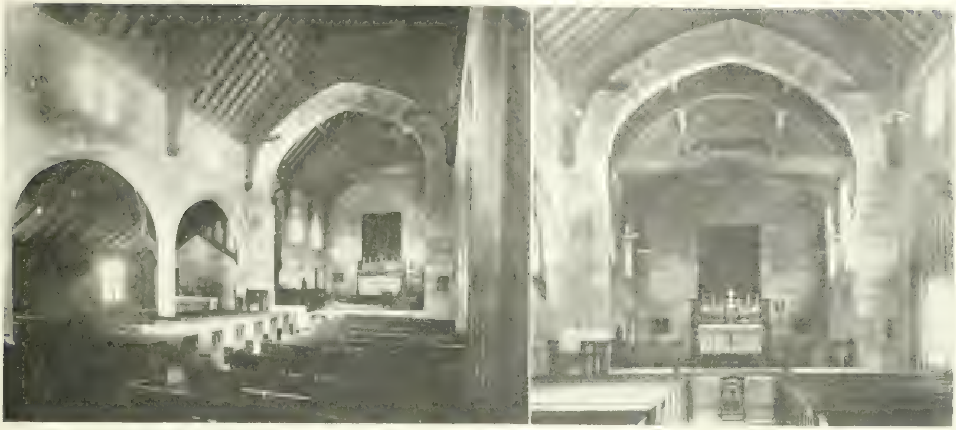

Fig. 1—Interior Views—St. Luke's Church, Chelsea, Mass.

a bad name that no one will have the courage to propose it.

FRANK A. BOURNE.

70 Kilby St.,
Boston

Editorial Note—Mr. Bourne forwards photographs, both interior and exterior, of St. Luke's church, Chelsea, Mass., showing the use of large concrete block which serve admirably without any special treatment, for the interior and the exterior wall surfaces. One of the illustrations also shows the window tracery in St. Luke's. Another use of the concrete block in church construction is in the Church of the Epiphany, Dorchester, Mass., also designed by Mr. Bourne. St. Luke's church was built about six years ago at a cost of $14,000 complete. It has a seating capacity of 250 on the main floor and 75 in the gallery. Mr. Bourne figures the comparative cost of stone, brick, concrete and wood per seating, in church construction as follows: Stone, $80; brick, $60; concrete, $50; wood, $40; making the cost of churches of the four different materials, with seating capacity of 300, as follows: $24,000, $18,000, $15,000 and $12,000. The foundations of St. Luke's church below ground are of rough local stone, and besides this use of stone, the only use of material other than concrete is in the woodwork of the doors, the roof, the temporary walls on one side and the furniture. Hot air heat is used and this apparatus is in a tunel 3′ 6″ wide under the center aisle. This tunnel is enlarged for the heater itself and has two outside connections for fresh air. The walls of the tunnel are of poured concrete 8″ thick, cast in wooden forms. The block used in the construction of the church are 32″x 12″x12″ with two 4-in. hollow spaces. The corner block are L-shaped, 16″ across the ends.

In mentioning the use of concrete block in this church in an article which he wrote for a church paper, Mr. Bourne lays great stress upon the importance of having the exterior surface of the block waterproof; this to be accomplished by using a richer and wetter mixture on the face side. The particular block used in this church were tested by the Ordnance Department, U. S. Army, at the Watertown Arsenal, undergoing a pressure test of 800,000 lbs. without fracture. The concrete used in the block was of a mixture of 1 part Edison Portland cement, 2 parts coarse, clean, sharp, bank sand and 3 parts crushed stone passing a ¾″ screen. This stone is locally known as "Roxbury pudding-stone." Integral waterproofing was mixed dry with the cement in the manufacture of the block. The block cost about 35c per cu. ft. delivered on the job, whereas limestone would have cost 70c to 80c per cu. ft., rough from the quarry.

* * *

Methods of Design and Concrete Construction

The use of concrete is not a new thing; it is as old almost as the world. The Romans used it as a method of construction and also as a fill, with the permanent forms of brick veneer or stone. The Spaniards and Italians both used it and the Mexicans also.

The principal types of architecture developed along these lines of construction are those of Spain and Italy particularly and the best modern expression of this type of construction in America is to be found in Carrere and Hastings' Ponce De Leon and Alcazar hotels in Florida.

These buildings are of shell concrete with terra cotta and brick trimmings around the openings and with Spanish tile roof with necessary overhang. The color contrast gives the plain wall surface additional value.

This type or similar architecture must be used in order to get value and beauty from the simplicity of a straightforward monolithic concrete wall. Classic or Rennaissance forms in cast concrete are at best poor imitations of the genuine living styles; so that the sooner we realize the value of concrete beams and corbels carrying a red tile overhang cornice instead of a classic imitation, just so much the sooner shall we arrive at the solution of our problems, for construction dominates and determines style.

Now as to the concrete block, the units and proportions as at present used are wrong for our purpose. Our brick unit is 2¼″ high by 8″ long, 4″ deep and with the headers showing, worked out in diaper pattern or in a simple binding course, forms a 2¼″ x 4″ continuous line every 17½″ apart in height.

These horizontal courses of headers show construction as well as design and should mark the way for concrete block to follow.

Our window openings, our door openings, our sill heights and lintel heights are worked out upon this 2¼″ x 8″ x 4″ unit and the cutting required to adjust the opening one way or the other to this unit is of small consequence; in fact it is generally recognized and taken care of in the original figuring of the plans.

The present concrete block is an illy-shaped unit and impossible to use, so in order to work out good proportions in accordance with our ideas and construction a new block should be used of very much the same proportion as our brick unit. It should not be much over 5½″ x 16″ x 8″ nor less than 4″ x 12″ x 6″ or a corresponding unit in proportion to these sizes. Say 6″ x 18″ instead of 5½″ x 16″ if desired as this slight variation would not interfere with the proportion of the structural voids and solids.

The main point in making this suggestion is that instead of having the block over high in proportion to the length we would have something which would approximate the present brick sizes which to us have become standardized. Indeed the great majority of people believe good brick work with good sized joints showing construction has become a beautiful thing.

In all concrete structures of whatever character, they are not designed as those of the architect, the steel engineer nor the masonry expert, but with the shop assembling of unit forms now recognized as a necessity, we hope in time to obtain a very high level and a distinct type of architecture. To my mind the proper anchoring of all unit forms one to another and their absolute contact and cohesion with proper mixture will put concrete construction beyond the possibility of collapse and the present method of merely placing the beam with its steel supports over the proposed columns or wall will have become a thing of the past and an obsolete method.

The danger to be pointed out in not anchoring and securing all steel members one to another in concrete construction is to be feared:

1st—From electrolysis—An arc is formed unless direct contact is made.

2nd—From constant jarring of machinery and heavy loads as in the case of the stairway of the Long Island R. R. or the probability of earthquakes, fire, etc.

The greatest present drawback to concrete construction, however, is that with few exceptions none of the larger concrete buildings have been designed by men who rank in the first class of the architectural profession. Such buildings should be given to men of this rank to design; men who will think out the problems and express in the work and material the method of construction; otherwise it is improbable that we shall ever have first class concrete buildings or that this type will ever develop as rapidly as it should.

Henry Clay Carrel, F. A. I. A.
Gillespie and Carrel, Architects,
423 Broadway, N. Y. C.

Editorial Note—The foregoing letter from Mr. Carrel comes in response to our invitation to architects and others to discuss the architectural development of concrete block. His recommendations as to concrete block are at least interesting and his other remarks as to concrete construction are quite novel, indeed. We hope that they will provoke further discussion. Mr. Carrel's views of the architectural profession in connection with the use of concrete prompt us to say that the reason many architects (who may be considered "in the first class of the architectural profession") have not been called upon to execute some of the important works in concrete is for the simple reason that they have been extremely and unwarrantedly conservative in an appreciation of concrete. They have seemed to lag in bringing themselves to the task of studying the new material—for concrete, as now understood, *is new*, despite Mr. Carrel's reference to its ancient application. Mr. Carrel appears to put the onus upon the public, when as a matter of fact, the public has preceded many in the architectural profession in application and adoption of concrete. If the architects in the *first class* to whom Mr. Carrel refers clung conservatively to the stone and brick mediums of their past achievements, unwilling to master new problems for the sake of new and progressive achievements, are we to blame the public for its appreciation and support of new masters—masters of the new material, whose achievements in concrete alone are sufficient to create *a new first class*—a first class bearing the distinction not of conventionality and adherence to custom, but of prowess as pioneers? If they have not yet succeeded fully—for success is never fully achieved—they at least have shown the way in which the ultra conservative may, by public demand, be induced to follow. There can be no architectural development of concrete without architects. Nothing surely is truer than that. If concrete does not meet architectural demands in the mere details of its form and application and treatment, who but the architects must tell us why? What have they to show who find the most fault? The architects may do as they will with concrete. There is no material more obedient to their demands. They have but to specify. It is for this reason that we welcome the views of the architects. We are grateful to Mr. Carrel, particularly in view of the fact that he has afforded us an opportunity to propound a question. And we repeat that question: Who can remedy the architectural treatment of concrete, if not the architects?—The Editors.

* * *

The Development of Concrete Block

I am greatly interested in the use of concrete block, which I believe should have still greater development.

The vital mistake which manufacturers and users of concrete have made is, in my opinion, trying to imitate other materials. Concrete is an excellent material, worthy to stand on its own merits. Good architecture certainly means, first of all, honesty and sincerity and not imitation. It is repugnant to every sense to paint galvanized iron to represent brick, or to grain stucco to represent marble, or to cast concrete to imitate rock-faced stone. This last offense has been one of the most heinous and prevalent architectural crimes, and has been quite sufficient to prejudice many people against the use of concrete. Concrete is a material subject to a variety of tool or cast surface and texture effects without the necessity of imitating other material. It seems to me unnecessary to use the term "artificial stone," but however that may be, I certainly wish it were possible to fine every man who is guilty of building a rock-faced concrete house.

Incidentally, it seems to me that integral concrete block, with true joints, will be of great use to architects to overcome difficulties of surface treatment, shrinkage, etc., inherent in mass concrete. Architects will be pleased when they can be sure that the market can furnish reliable concrete block with required surfaces and sizes.

D. Everett Waid, F. A. I. A.
1 Madison Ave., N. Y. C.

Reinforced Concrete Buildings in Australia

[These columns are usually reserved for expressions of opinion on concrete and cement and their many uses, for the demand on our space is too heavy to permit publication of letters commending the work of the paper. The following letter, however, describes pioneer work in advancing concrete building and illustrates one phase of the work done by a technical industrial journal. It is a privilege to be cooperating with engineers in many lands to advance the cause of better, fireproof permanent building.—The Editors.]

As a subscriber to your magazine since the beginning of 1907, through the firm of Gordon & Gotch—the writer is pleased to see the splendid advance and success attending its publication.

The various articles on reinforced concrete are and always were interesting and educative and it may be stated that it was through the discussions on reinforced concrete generally and particularly those on the "mushroom" system contributed by C. A. P. Turner, that the system was adopted in buildings erected in Melbourne.

The introduction of reinforced concrete for the erection of buildings here was attended with much argument, the first concrete building being designed in 1906, by the writer, who, on presenting the plans to the building department, was practically thrown down stairs.

By persistent effort, however, a special permit was granted to erect a factory for Messrs. Snider & Abrahams in reinforced concrete, but the "mushroom" system of construction was adopted after the permit was secured. The successful erection of the building gave reason for others to follow. A new building code has been in preparation for several years. So far it has not come to light, and we are working under the regulations of the present code for the erection of steel frames and reinforced concrete buildings, with special reference to and permission of the Court of Referees.

Building operations in Australia are somewhat restricted owing to money tightness, but we hope with a change of Parliament administration in the near future to resume normal activity.

H. R. Crawford.
Melbourne, Australia.

* * *

Grading Aggregates

Referring to the editorial comment in the Dec., 1912, issue, p. 86, entitled "Graded Aggregates for Concrete Work"; and also to Consultation Item 260, "Graded Aggregates," in the Jan., 1913, issue, p. 21; from my experience, I have found that concrete aggregate cannot be prepared as suggested in the Dec. issue with assurance of a uniform composition of the resulting concrete. This is due to the separation by flow of such a composite aggregate. Such a prepared aggregate is variable in the proportion of its different sizes of particles. This objection is recognized in discussing the far more perfect method suggested by the correspondent in the Jan. issue (Consultation 260).

The efficient handling of concrete aggregates requires separation with screens into the different sizes, and then re-combining the material of different sizes in accurate and scientific proportion.

A few sieve analyses, using screens and sieves of various size mesh, will convince anyone of the great variation there is in the proportion of sizes of particles and grains in a composition aggregate.

G. J. Griesenauer

Cement Tester,
C. M. & St. P. Ry.,
Chicago

* * *

Factory-Made Sidewalk Slabs

In regard to the manufacture of concrete sidewalk tile.[1] These tile are made 2" thick, the grouting or bottom layer being 1½" thick mixed 1 part Portland cement to 5 parts clean, coarse, sharp sand, and the top layer, or face, is ½" thick, mixed 1 part Portland cement to 2 parts clean, sharp, screened sand. We make these tile in two sizes, 18"x18" and 24"x24" in molds especially built for that purpose, the sides or frame being constructed of iron 3½" high and boxed up underneath with plank or boards to bring them up to a convenient height for the tile maker to tamp the material, which is done by hand. At the bottom or just underneath the 3½-in. iron frame there is a false bottom of 2-in. planking through which four upright iron rods project, which, operated by a foot-lever, act as a lift to raise the finished tile up above the top of the mold so that the tile-maker and helper can easily insert their hands under the pallet on which the tile rests, lift the tile, together with the pallet, away from the mold and set it on the racks where it is left until set hard enough to be carried out and piled up.

We regret that we have no photographs showing the manufacture of these tile. We do not consider the cost of sidewalks made from tile to be any less than that of the poured walks, in fact we would just as soon construct the poured-in-place walk 3½" thick at the same price which we can get for the tile walks, and on sand soil the poured walk is no doubt the best, while on clay soil such a walk cracks from the heaving by the frost, while the walk constructed on clay soil of tile will tend to crack where the tile are joined and can be taken up and re-laid. These repairs cost less than taking up the poured-in-place walk and laying a new one.

M. G. Warner

Plymouth Paving & Construction Co.
Minneapolis, Minn.

Concrete Block School

We enclose a photograph and a small sketch of the ground plans of the little Masonboro Sound school house (see Figs. 1 and 2).

This was built of concrete block for $2,200, complete. Material used in the concrete, the fine broken shells from the beach; mixture: 1 part Alpha Portland cement, 3 parts sand and 4 parts of shells, molded in my own concrete block machine. The inside of the building is ceiled overhead and the walls plastered directly on the block; the roof is of cedar shingles. The house has a basement for a furnace. The superintendent of the public schools is very proud of it and has spoken to me about building a 20-room building with block. This building cost less than one half what a less convenient brick school house would have cost.

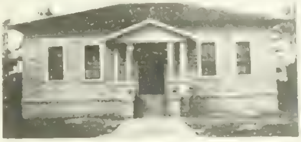

Fig. 1—Concrete Block School House Built for $2,200

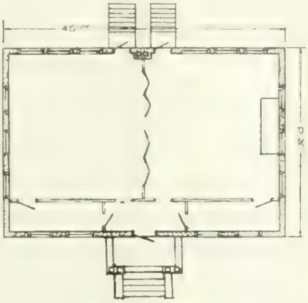

Fig. 2—Plan of School

J. C. Herring.

Wilmington, N. C.

The Use of Concrete For Tanning Tanks

Following the article in the Apr., 1913, issue of Concrete-Cement Age on concrete in tannery construction, there has been some interesting investigation as to the effect on concrete tank containers of solutions used in tanning leather. In this it is interesting to know the result of some investigations conducted by the Assoc. of Amer. Port. Cem. Manfrs. In a report submitted to this Association, it is stated that tanning solutions in ordinary use do not in any way affect the concrete. The test tanks were built, using a 1:2:4 concrete, mixed wet, with trap rock as the aggregate. There was no special treatment of the concrete and the only effect noted on the contents was a slight darkening of the leather the first time the tank was charged. The report states that it is safe to use a properly prepared concrete tank and that plain concrete is as good as any specially treated concrete, or even better. The tanks should first be thoroughly impregnated with the tanning solution before introducing the leather.

Additional experiments were made to determine the value of different waterproofing materials. These were both incorporated in the concrete wall and used as a surface coating. The surface facings used were of neat cement, a neat cement paste containing 15% residual oil; neat cement paste containing 15% residual oil and 7% barytes. The materials mixed with the concrete for the structure of the tank itself were 15% residual oil, and 15% residual oil and 7% barytes.

The report states that in no case was a specially treated tank found to be better than one built of plain concrete.

A Concrete Guard to Protect Tree in Thoroughfare

The officials of Glendale, Cal., have adopted a unique method for the protection of a tree in that city. When the land in which the tree stands was laid out into building lots it was found that the tree stood in the center of one of the principal streets. Because of the tree's natural beauty and also owing to a scarcity of foliage in that vicinity, it was decided to save the tree. A circular concrete wall was built around it, the inner side of which ranged from 3' to 6' from the outside of the trunk. The wall is 2' high and 6" thick. Up to the present time the experiment has been entirely successful.

Tree Protected By Concrete Wall

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[1] See p. 172 Apr., 1913, issue

NEW BOOKS

An Extension of the Dewey Decimal System of Classification Applied to the Engineering Industries. By L. P. Breckenridge and G. A. Goodenough. The Eng. Experiment Station, Univ. of Ill., Urbana, Ill. 6"x9", 118 pp., paper bound, 50 cts.

The filing and classification of engineering data have become a matter of much importance, and this bulletin was prepared for use as a guide in carrying out such work. The original edition of Bulletin No. 9 was subject to the usual gratuitous distribution, and the subsequent demands were such that a second edition was printed and ultimately distributed. Altogether 20,000 copies were sent out. The demand having continued, it was finally decided again to revise and to print a limited edition. This has now been accomplished and the revised bulletin, much extended as compared with the original edition, is ready for distribution. It presents subdivisions of subjects in such detail as to constitute a complete classification for most engineering industries, even though they are highly specialized.

* * *

Volume XI 2nd Series "The Coal Deposits of Missouri," By Henry Hinds. Missouri Bureau of Geology and Mines, Rolla, Mo. 10½"x7", cloth bound, 503 pp., illustrated.

This volume reports work done by the Bureau of Geology & Mines cooperating with the United States Geological Survey in completing the co-operative geologic and economic survey of the Missouri coal fields. The matter is covered in detail, with complete maps, sketches, etc.

* * *

Report of Tests of Partitions by Fire and Water. Made under the direction of Virgil D. Allen, City, Bld. Insp., Cleveland. 9"x6", paper bound, 78 pp., illustrated.

While the tests referred to were described in detail in the Aug., 1912, issue of this journal, the book referred to is a completed detailed report presenting all the information. It contains data on the fire-resisting qualities of different partitions which should be in the library of every engineer.

A new building at Water and Concrete Sts., Waterloo, Ia., is being erected for the Cement Stave Silo Co.

Elementary Principles of Reinforced Concrete, by Ewart S. Andrews, B. Sc., Lecturer in the theory and design of structures at Goldsmiths' College, New Cross, England. A textbook for the use of students, engineers, architects and builders. 4¾"x 7½". 12+193 pp.; 57 figures in the text. Bound in buckram. Scott, Greenwood & Son, London. D. Van Nostrand Co., N. Y. C. $1.25 net.

The author states that his reason for producing this book was the lack of a simple and inexpensive book upon reinforced concrete. He has succeeded. One of the faults of reinforced concrete literature has been the monumental treatises filled with abstruse and involved analyses of the problems of design in which one must wade through a slough of mathematics in order to separate the essentials from the non-essentials; and a few handbooks based upon premises given in a separate volume and limited in their value to those particular values of stresses and ratios of *Es* to *Ec* which were favored by their authors. Sometimes these values do not agree with those the designer must use in order to comply with the peculiar provisions of building codes.

Mr. Andrews has given a brief, concise and easily understood explanation of the theory, and of more than one theory in several cases. Then he has worked out a numerical application of the theory and compared it with another theory applicable to the same case. The why and the wherefore of each step in the problem is given or referred to and the line of reasoning adopted does not soar into the realms of higher mathematics, in which all but a few of the *illuminati* have the sensations of a green aeroplane operator.

The notation adopted in this book is that recommended by the Concrete Institute of Great Britian and the author expresses the hope that all books in the English language be based on this notation, even if writers in foreign tongues do not adopt it. As this is an English work, this desire is consistent. The present state of the system of notation found in various books is to be regretted. An international scheme of notation is to be desired, not only in reinforced concrete notation, but other lines as well. Until this time arrives more or less trouble will be experienced in converting formulas to known notation.

The book contains some good designing diagrams of a simple character, but owing to its small size these are condensed to a degree that makes them difficult to read, except with the aid of a magnifying glass, and interpolation is occasionally difficult. Its convenient size, however, will make the book extremely useful.

University activity in extending the scope of curriculum to include concrete work is announced by the Kansas Agricultural college. The institution offers a course in making sidewalks, feeding floors, tanks, cisterns, fence posts and driveways. Instruction in these matters will be made as thorough as possible.

Concrete Organizations, Officials and Conventions

National Association of Cement Users, Edward E. Krauss, Secretary, Harrison Building, Philadelphia, Pa.

Association of American Portland Cement Manufacturers, Percy H. Wilson, Secretary. Land Title Building, Philadelphia, Pa.

American Highway Association, J. E. Pennybacker, Jr., Secretary, Colorado Building, Washington, D. C.

Northwestern Cement Products Association, J. C. VanDoorn, Secretary, Security Bank Bldg., Minneapolis, Minn.

Cement Products Exhibition Co., 72 West Adams St., Chicago, Ill.; Secy.-Treas., J. U. C. McDaniel, 108 La Salle St., Chicago, Ill.

Nebraska Cement Users' Association, Secy. Treas., Frank Whipperman, Omaha, Neb.

Iowa Association of Cement Users, Henry H. Dean, Glenwood, Ia.. Secretary.

Canadian Cement and Concrete Association, William Smith, Secretary, 57 East Adelaide St., Toronto, Ont.

Announcement is made of the 13th annual six-weeks summer school of the College of Engineering of the Univ. of Wis., which opens June 23.

Courses of instruction and laboratory practice are offered in electrical, hydraulic, steam and gas engineering, mechanical drawing, applied mechanics, testing of materials, machine design, shopwork and surveying, in addition to which subjects may be taken in the College of Letters and Science.

For further information address F. E. Turneaure, Univ. of Wis., Madison, Wis.

A new cement mill is projected at Roseburg, Oregon, by the Roseburg Commercial Club. D. W. Riedel, Portland, a large quarry owner, is interested in the plans.

McKiernan-Terry Drill Co. is now occupying new offices, 1064 to 1072 Woolworth Bldg., 233 Broadway, N. Y. C.

According to German cement specifications recently published, concrete tanks cannot be used to store solutions of potassium chloride (KCl) if the solution contains magnesium chloride ($MgCl_2$) to any extent. In general, the specifications require cement which will develop a higher compressive value than past specifications. The action of oil on concrete has been investigated by the Royal Testing Laboratory at Gross-Lichterfelde and specimens hardened 28 days in air, and then immersed in oil for various periods have shown a considerable loss in strength when compared with specimens which had not been immersed in oil.

Some Preferences as to Coming Cement Shows

In the past five years the Cement Shows have demonstrated their value as a factor in the up-growth of the concrete industry. There is no doubt that they play a most important part in collating and bringing before all concrete men the best that is being done in all lines. It is important that these shows shall be so arranged as to time and place that they will do the best work. The men who are conducting these shows, making themselves responsible for the time and money involved, are to be commended and congratulated on the work done. They have been in the forefront of a good work, and the work has been well done. The shows, however, are *of* the industry and *for* the industry and we know that a good end may be served and the industry as a whole aided, by gathering and crystallizing opinion among the exhibitors in general, as to how the 1913 Shows may best be held. The canvass, the results of which are covered in the following paragraphs, has been carried out to secure first-hand opinion as to future shows. The Cement Products Exhibition Co. has this year, as in past years, sent out circulars to secure the opinion of exhibitors. The canvass conducted by CONCRETE-CEMENT AGE parallels and supplements this work.

A postal card folder with a return schedule blank was sent to the entire list of exhibitors and possible exhibitors. Out of a total of 148 cards received, 125 expressed definite opinion and on the returns of these 125 the analysis in the following paragraphs is based.

On the postal card to be returned the following questions were asked:

1. **Where** should Cement Shows be held?
   Please indicate four cities in order of preference.
2. **When** should they be held?
3. At the last Chicago Show there was a definite trend of opinion in favor of one Big Show a year, and one only. What is your opinion of this?

Location: The first, and in a way the major consideration, is the location of the shows. The following total (Table 1) is a complete canvass of all the votes. This shows a total of 34 cities in which some exhibitors think a cement show might well be held. Eliminating the "stragglers," Table II shows a list of the first six cities as judged by their total votes.

It is significant to note how far Chicago is in the lead as a popular place for the Cement Show. It is also significant to note that a city in a central section, or in the territory which could be served by Detroit, Cleveland or Pittsburgh, if grouped together, would take second place in total number of votes. Table II shows that for first choice Chicago has 74½% of the ballots cast for the six leading cities, 58½% second place, 50 6/10% for third and 55% for fourth. For all four places it has 61½% of the total votes.

TABLE I

City	Choice 1st	2nd	3rd	4th	Total
Atlanta			2	1	3
Baltimore			1		1
Boston	2	3	2		7
Buffalo		2	1	1	4
Cincinnati	1	3	4	4	12
Chicago	84	55	37	33	209
Cleveland	3	5	7	4	19
Columbus			2		2
Denver			1		1
Detroit	2	11	4	3	20
Fort Worth			1		1
Indianapolis		1	1	3	5
Kansas City	4	4	8	4	20
Los Angeles	1				1
Louisville		1	1	1	3
Manitoba				1	1
Mason City, Ia.	1			1	2
Minneapolis	2			2	4
Milwaukee		3	1	2	6
Memphis				2	2
Nashville			1	1	2
New Orleans			1	1	2
New York	22	13	9	7	51
Omaha	2	5	2	1	10
Pittsburgh	1	5	7	4	17
Philadelphia	5	3		4	12
Richmond		1			1
Salt Lake City				1	1
San Francisco	1	2	3	3	9
St. Louis	1	5	9	9	24
St. Paul				1	1
Toledo			1		1
Troy				1	1
Washington			1	2	3
TOTAL	132	122	108	96	458

TABLE II

City	Choice 1st	2nd	3rd	4th	Total
Chicago	84	55	37	33	209
New York	22	13	9	7	51
St. Louis	1	5	9	9	24
Detroit	2	11	4	3	20
Cleveland	3	5	7	4	19
Pittsburgh	1	5	7	4	17
TOTAL	113	94	73	60	340

Time: The second point we consider is the months in which to hold the shows and there are many factors involved here that the average exhibitor does not consider. The general attitude is that the Cement Shows should be held while construction work is light, because of cold weather. That is, they should be held after the building season has closed and before it opens. Whether they should be held immediately after the season closes or just before it opens is an open question, and many exhibitors have expressed very definite opinion on this. On 114 cards, a definite preference as to time was stated. Table III schedules cards of those who selected one month only, as follows:

TABLE III

December	3
January	42
February	39
March	11

Table IV shows cards of those who indicated more than one month, as follows:

TABLE IV

December and January	4
December, January and February	9
February and March	3

One Big Show: As was pointed out in the Feb., 1913, issue, there has been more or less of an undercurrent of opinion in favor of doing away with the smaller shows and concentrating on one large exhibition. To get a more complete expression of opinion along this line, the third question was asked. In answer to this, 94 replies endorsed the one big Show idea emphatically, while most of the cards indicated only a terse O. K. on the suggestion. Some of the replies went into the matter more in detail, and are worth quoting as follows:

"Concentrate in one Show and make the exhibits more educational."

"One big Show is a good idea. This should alternate between St. Louis and Chicago."

"We cannot see how other people find it convenient to attend more than one Show."

"Thorough co-operation in one good Show would be better for the industry."

"Hold one Show and make it last two weeks."

"One Show is sufficient, but it should cover a large territory in rotation."

"One Show and hold it in connection with the N. A. C. U. convention."

"One big show and cement plants should furnish more instructive exhibits."

"Hold one Show a year, every other year in Chicago and alternating with St. Louis, Atlanta and Philadelphia."

Postal cards from 10 firms indicate a preference for more than one Show. Some of the notations on these are as follows:

"We need two Shows, one in the East and another in the Central West."

"Separate Shows should be held in large distributing points."

"There should be one Show in the Central States and in each territory, the East, the West and the Southern States."

"One Show would not furnish the opportunity for a great many small contractors throughout the country, on account of the expense."

"A Show should be held in both East and West."

"We ought to have two at least."

"I believe that two Shows held in succession at Chicago and Philadelphia should prove a success."

"Scatter the Shows. How about Montreal, Toronto or some other Canadian city?"

"At least two Shows."

One postal card suggested one big Show at San Francisco in 1915 in connection with the Panama-Pacific Exhibition. This has already been suggested by CONCRETE-CEMENT AGE, and might well be considered. Another exhibitor suggests that Shows every other year held at Chicago might work out very well.

Summing up the active opinion on the three questions asked, it stands as follows:

TABLE V

In favor of one big Show	94
In favor of more than one Show	10
One Show every other year	1

The canvass is of value as showing a keen and widespread interest in the value of Cement Shows, and indicates definitely the trend of opinion as to future shows.

Recessed Steel Panels as Form Units

The waste in labor and lumber in wood forming has been perhaps the greatest drawback to reinforced concrete construction. Wherever careful cost data are kept, the expense of the centering, which is erected only to be later removed, is more than that of the concrete structure itself. To illustrate:—On a certain large building constructed by the Nicola Bldg. Co., Pittsburgh, where a thorough system and detailed costs were kept for one of the reinforced floors, the material and labor for the concrete work including all reinforcing, cost $600. For this same floor, the cost of the wood centering, preparatory to pouring, was $900, 1½ times the total expense of the concrete structure itself.

A system of floor centering has been devised by M. D. Morrill[1] which, it is believed, will curtail much of this useless expense, and at the same time produce a light, strong system of construction, adjustable and suitable to many types of buildings, such as factories, lofts, office buildings, hotels and apartments. The forms are largely self-centered, requiring no posts or temporary supports, unless the spans are considerable.

When the walls, columns and partitions are brought to the height of the floor slab, perforated straps are laid over the walls of partitions or girder forms, which are encased in light metal shields or pipes for ease in removal. Upon these flat straps, 2-in. x 6-in. stringers are spaced approximately 3′ o. c. These stringers can, if necessary, be set diagonally in order to prevent cutting to exact lengths. After these are in place, sheet steel angles with a 6-in. leg are placed covering the ends of these wooden stringers. These angles are of ⅛-in. metal in long lengths, lapping so as to be adjustable to various spans. After this angle border is completed about the proposed panel, the recessed panel plates, which are of pressed steel, generally 3′ x 3′ are dropped into place and clipped together at the flanges by wedge connections. These panels form a ribbed or panelled ceiling; the panels themselves are 6″ in depth. Ribs are reinforced by rods in both directions. The concrete is then poured, giving a thickness over the panels of 2″ which may be reinforced with wire mesh, if necessary; the depth of the ribs or cross-beams being 8″. After the concrete has set, the supporting straps are withdrawn; the wood stringers lowered, the border angles and plates are removed. This leaves a recessed paneled ceiling of smooth finish, as the steel plates are thoroughly oiled.

These recessed panel plates can be utilized for walls, and partitions, also; the flat plates of similar size are used on the exterior to obtain a smooth surface.

Where a furred wall is desired, or where the interior must be a flat surface, heavy wires are left projecting between the panel plates.

After the forms are removed, expanded metal or wire lath is laid on the projecting wires and these wires clinched, when the wall is ready for the plastering.

It is also proposed to utilize these panel plates for retaining walls, silos and other forms of construction, reducing materially the amount of concrete necessary, and still affording a substantial and stable construction. For walls and floors

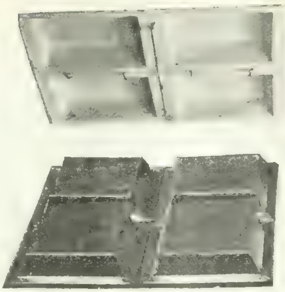

Fig. 1—Shows (Above) a Section of Floor as Seen from Below, Poured Over the Section of Panel Plates as Seen from Above

Note the wires projecting, over which wire lath is laid, and projecting wires clinched. Note also smooth surface left by steel forms. The ribs are spaced 3 ft. on centers, reinforced in both directions, making a light, yet strong construction

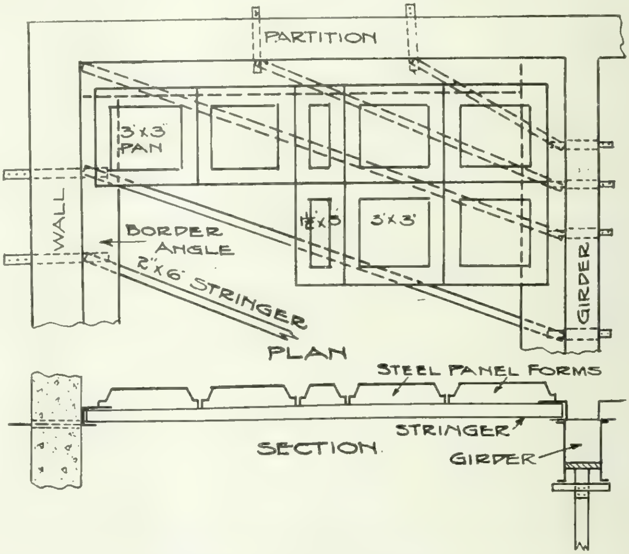

Fig. 3—Plan and Section of Floor Construction Using Paneled Plates

This shows the adjustment made possible with the angle, and the half-size panel. A suggested girder detail is shown

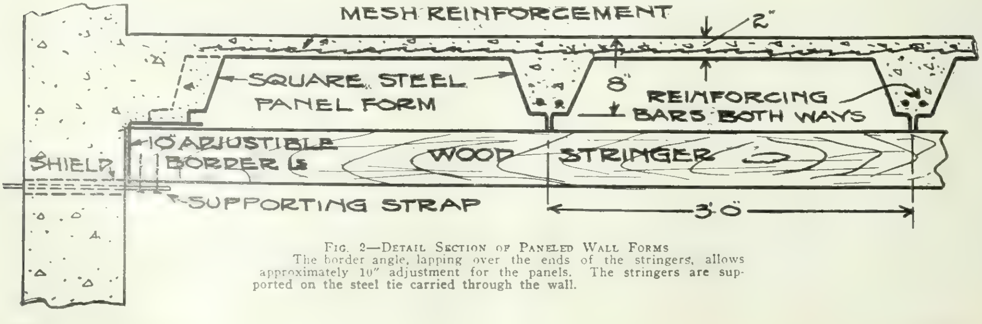

Fig. 2—Detail Section of Paneled Wall Forms

The border angle, lapping over the ends of the stringers, allows approximately 10″ adjustment for the panels. The stringers are supported on the steel tie carried through the wall.

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[1] Read and Morrill, Brooklyn, N. Y.

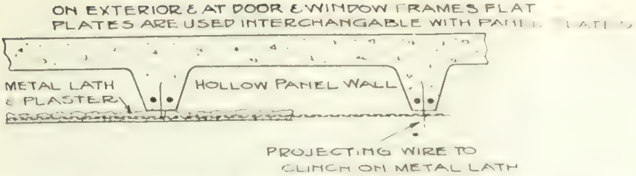

ON EXTERIOR & AT DOOR & WINDOW FRAMES FLAT PLATES ARE USED INTERCHANGABLE WITH PANEL PLATES
METAL LATH & PLASTER
HOLLOW PANEL WALL
PROJECTING WIRE TO CLINCH ON METAL LATH

Fig. 4—Horizontal Section of Hollow Panel Wall Construction
The day's pouring would be stopped immediately [illegible]

of higher buildings, this system offers a considerable advantage both through the saving in concrete and in the dead load. The paneled ceiling formed by this process has a decorative appearance, but where a flat ceiling is required wire lath for plaster is applied by a process similar to that used on walls.

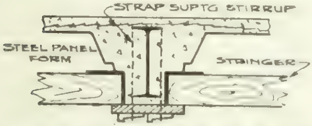


Fig. 5—Paneled Wall Forms Used in Fire-proofing Work
The bottom board is suspended from the I-beam by wires or strap stirrups punched for wedge connections. On this the stringers or joists are placed, with a border angle, and the steel panels are placed as in the floor construction

The same equipment can be used for concrete slabs between steel beams, the beams themselves forming a support for the temporary centering. Adjustment to panels of all widths and lengths can be made with only two sizes of panel plates. The standard plates are 3′ x 3′ and other plates half this size. Further adjustment is possible in the width of the V-beam between the panel.

How to Lay Out Buildings Lots or Foundations

Many a builder has been seriously handicapped in starting work because of inability to lay out building foundations or building lots. The cost of the engineer's transit has put its use in many cases out of the question. Waiting for a civil engineer to do the job for him has caused annoyance as well as delay. Present day builders are finding it convenient and economical to own a simple surveying instrument for their own use.

The use of a surveying instrument is not nearly so difficult as may be imagined. In the instruments designed for building work, confusing devices although valuable to the engineer, have been omitted.

One of the first things to learn in using a transit is its initial adjustment, that is, making the transit perfectly level.[1] To do this the legs of the instrument are first set into the ground firmly so that the adjustment may not be disturbed. The points of the legs should, if possible, make an equilateral triangle with the center of the instrument directly over the point in question. It is then brought to an approximate level by adjusting the lower parts of the extension or telescope legs. Greater refinement in level is secured by adjusting the leveling screws between the plate and the tripod head. This is done by bringing the level over one pair of the leveling screws and turning the pair of opposite screws, one in and another out until the bubble appears in the center of the level glass. Then turn the sight tube or telescope through an angle of 90° so that it is directly over the other pair of screws and again adjust the bubble to the center of the glass by means of the two leveling screws. This operation should be continued until the bubble stands in the center of the glass, no matter in what direction the level may be turned. Do not wedge the plates by turning the screws too tightly.

By means of a plumb-bob, suspended from the hook under the tripod head, the center of the instrument is set directly over the station mark or corner of the lot or building to be laid out. After the transit has been carefully leveled, neither the hands nor the coat of the operator should be allowed to touch the legs of the instrument. When the instrument is set in soft ground, every care should be taken not to step near the legs.

If *A B* in Fig. 1 represents the street line, and the corner of the proposed building is at *C*, which is distant from the street line, *N C*, then a distance *O P* equal to *N C* should be measured from the street line at some point *O* which is at least as far from *N* as the length of the proposed building. For accurate work, the instrument should be set up at *O*, and taking sight on *A* or *B*, a 90° (right) angle should be turned, and on this line, at a distance *N C* from the line *A B* set the point *P*. The line *C P* will be parallel with the street. Set up the instrument at *C*, take sight on *P* and put in the point *D* at a distance from *C* equal to the width of the building. *D* is then the other front corner of the building.

To get the line at right angles to *C D*, leave the sights still directed on the stake at *P* and the sight tube clamped by means of the clamp screw and nut. Then turn the graduated arc until the index pointer can be passed into the zero mark by means of the push pin. Secure the graduated arc in that position by clamping the lever. Then turn the eye-end of the sight tube or telescope to the left until it has turned a right angle, or 90°. A sight along its new position will give the line *C F* on which the required distance is measured off to determine the corner *F*.

Next move the transit to *D* and level it up accurately. Direct the telescope to a rod or nail on the stake at corner *C*. Clamp the transit in this position and bring the zero of the arc to the index pointer as before. Then turn the eye-end

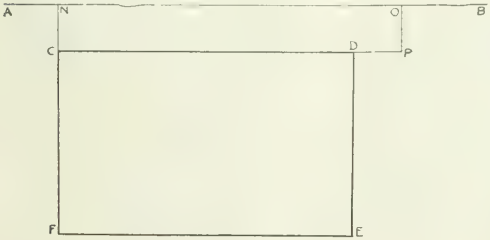


Fig. 1—Sketch Showing Location of Building

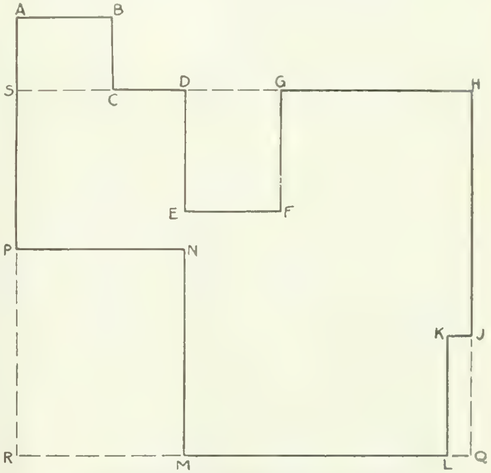


Fig. 2—Sketch Showing More Complicated Location

of the sight tube or telescope to the right until the index pointer has turned a right angle, or 90°. This will give the direction of *D E* on which line the width of the building or lot will be measured off, thus determining the corner *E*.

---

[1] These notes refer specifically to a builders' combination level and transit manufactured by the L. S. Starrett Co., Athol, Mass.

To prove the work and make sure that no errors have occurred, the transit should then be set up at *E* and if the distance *E F* equals the distance *C D* the work is proved to be correct. If either of these fails an error has been made, either in the measurements or in turning the angles. In this case the work must be repeated until it checks with itself.

The line *A B* may be either the side line or the center line of the street. A side line should not be used unless run from well authenticated points. In most city work, the center line of a street can be located without much difficulty. There are monuments at each street corner and at intermediate points, concerning which full information can be readily obtained at the city engineer's office.

Where the outline of the building is other than a rectangle, the procedure is just the same from one point to the next, but more points have to be arranged for and the final proving of the work is more likely to reveal a small error. It is usually advisable with an irregularly shaped building, such as shown in Fig. 2 to lay out first a large rectangle which will comprehend the entire building or a greater part of it. This is shown in Fig. 2 as the rectangle *H Q R S*. Having once established this accurately, the remaining portion of the lay-out will consist of small rectangles, each of which can be laid out itself and proved separately. As will be noted in the figure, these other rectangles are respectively *J K L Q, M N P R, A B C S*, and *D E F G*.

For accuracy a 100-ft. steel tape should be used. Measurements should be made to a pencil mark or a tack in the top of a stake driven into the ground. Always keep the tape level when measuring, using a plumb-bob to get an exact vertical over the point. When measuring more than 100′, or the length of the tape, every intermediate station or measuring point should be lined accurately from the instrument.

A Cement Handbook. U. S. Portland Cement Co., Denver, Col. 6″ x 4″, paper bound, 63 pp., illust. This booklet describes in detail the various parts of the extensive plant of this company. An important and interesting subject discussed is that under the title of "Portland Cement Facts and Factors," in which detailed facts about Portland cement are given; qualifications and rough tests are covered in detail. Interesting information is given on proportioning and mixing concrete; cost of concrete work, pavements and stucco work. This is a little booklet which concrete men will find of much value.

Forms for Monolithic Concrete Pipe and Manholes

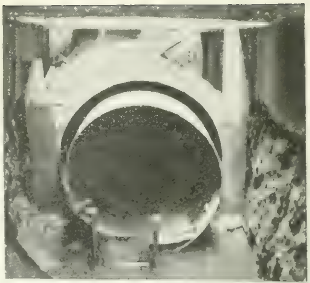
L. Y. Stayton, Tacoma, Wn., has devised, applied for patents, and already extensively used a collapsible steel centering which is especially adapted for use when a pipe line is laid in one continuous length—monolithic construction. The core can be left in place until the concrete has thoroughly set and may be reduced in size to pass through the cores adjacent to it which are being used (the concrete not having sufficiently set) and may be set up again in line to form a core for a new length of pipe. The core sheet is made of metal of such width as to form the circumference of the inside of the pipe and of a convenient length.

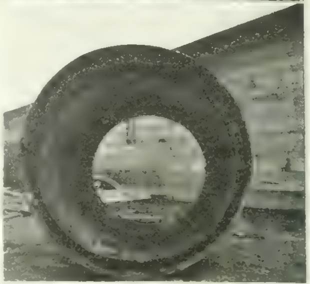
When the core is in use it is held by means of folding ribs which are placed at convenient intervals, and held by clips fastened to the core sheet. The system of forms also includes forms for manholes and other similar hollow structures. The inventor, himself a concrete pipe manufacturer and a contractor, says the forms make a convenient, rapid and economical system as demonstrated in construction work on the Pacific coast. It is a system whereby several different sizes of pipe may be constructed with the one shell and more rapidly than by any other method. By this system, Mr. Slayton says, a crew of nine men has shifted centering, mixed concrete by hand, and placed 85′ of 40-in. sewer 6″ thick in a day of eight hours. He says that with this system of centering monolithic continuous concrete pipe can be constructed with reinforcement, and if the specifications require a brick invert, this can be included and be encircled by the reinforcement, with but little extra trouble and the additional cost of the brick. Mr. Slayton writes: "I am at present laying a monolithic continuour pipe at Bremerton, Wn., in 36-in., 38-in. and 40-in. sizes where I have to contend with a flow of 5,000 gals. of spring water per hr.

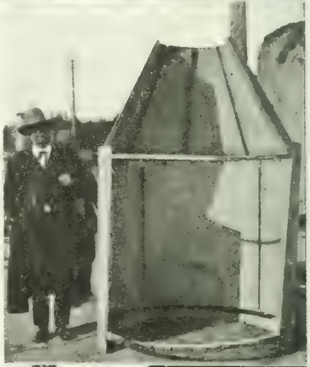
"Fig. 1 shows the work at Bremerton on the 36-in. monolithic pipe construction where a series of springs was encountered. A collapsible section is seen drawn forward from 95′ down the pipe line through 19 5-ft. sections standing in place. This section will be expanded (as soon as the concrete base is placed in front) to the size of sections through which it came.

"The same centering shown in Fig. 1 can be used in conjunction with outside mold held by outside rings to construct (outside of the ditch) a reinforced jointed pipe in as many different sizes as can be made in the ditch—i. e., six sizes: 36-in., 38-in., 40-in., 42-in., 44-in., 46-in.

"The form for manholes is shown in Figs. 3 and 4. All sections are easily removed after the concrete has set and as previously stated do not interfere with forms subsequently placed.







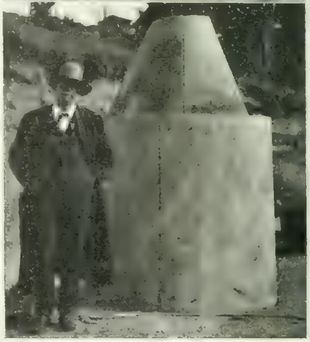
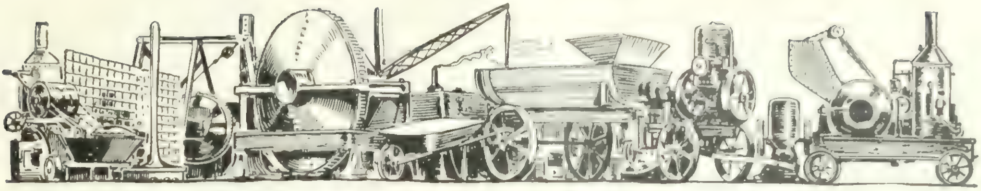


Fig. 1—Monolithic Pipe Construction—Passing a Collapsed Section of Form Through Expanded Sections in Use

Fig. 2—An Expanded Form Enclosing a Collapsed Section of Form for Pipe of Same Size

Fig. 3—Inside View of Manhole Form

Fig. 4—Outside View of Manhole Form



New Equipment, Methods and Materials

In this department the EDITORS endeavor to keep our subscribers informed upon new tools, methods, machines and materials used in this industry. It is in no sense a department for the benefit of advertisers. To secure attention the thing described must be new to our readers. No matter will be printed simply because an advertiser desires it. Likewise, no matter will be excluded simply because the article described is not advertised in this paper. We aim to keep our readers informed—suggestions for the improvement of this department are solicited.

A Step Form Making for Economical Work

The step form-holder shown in the accompanying illustrations has been developed and placed on the market by H. L. Park, a concrete contractor of Reading, Mass., and is meeting a real need in the field by affording an economical and efficient means for handling the usually difficult problem of centering for concrete steps.

A detailed inspection of Fig. 1 shows that these step forms are essentially short shoulders of timber superimposed in such a way as to make a rider or stringer for a flight of steps. By an ingenious arrangement, this rider can be used for steps of any ordinary rise and tread.

The adjustment for varying riser dimensions (from 6" to 8") is accomplished by building each step form of two planks, bolted together; and on the outside plank vertical slots are cut, reinforced with iron straps. By loosening the bolts the vertical dimension of the form can be increased or decreased as desired.

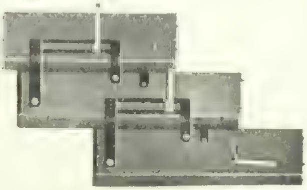


Fig. 1—Detail Showing Step Form Units

Fig. 1 shows plainly how different widths of treads are taken care of. To hold the shoulders in an accurate superimposed position a yoke, slotted horizontally as shown, is bolted to and extends below each form unit except the pair used to start the step. With the short eccentric lever set as shown at the left in Fig. 1, the slot in the yoke of the unit to be placed above, passes over it, and by turning the lever and swinging it down the eccentric is brought into play and the unit locked in place.

In operation, two stakes are driven firmly into the ground about 30 ins. away from the bottom step. The first form units can be placed directly against these, or, as shown in Fig. 3, a plank can be placed. Against the front of these units, the first riser board is placed. Short brads or steel points project about ½ in. from the end of each unit, and the riser board is held in place by tapping lightly so that it is forced over the points.

With the first riser accurately placed, the rough concrete for the first step is poured. Shoulders for the second step are placed and adjusted, and the concrete poured. This process is repeated until the flight is complete. The finishing starts at the top, of course, and

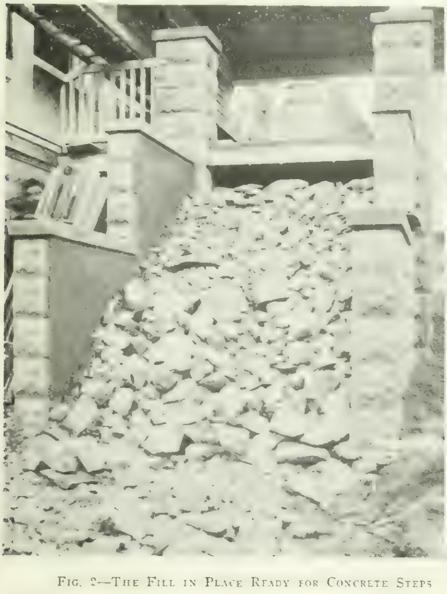


FIG. 2—THE FILL IN PLACE READY FOR CONCRETE STEPS

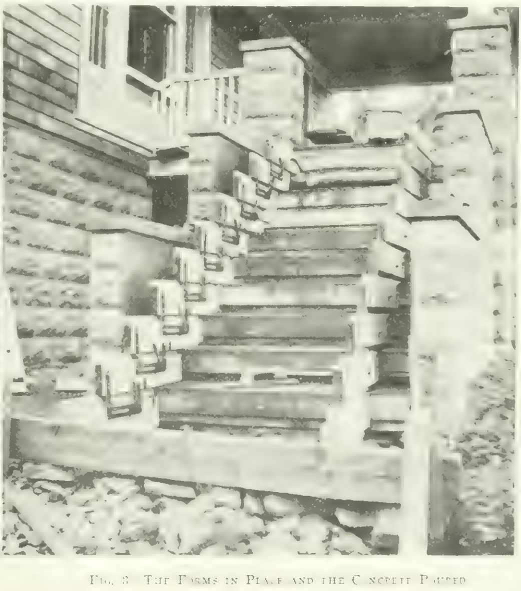


FIG. 3—THE FORMS IN PLACE AND THE CONCRETE POURED

comes down, the riser boards being removed if necessary, so that the riser face may be finished. On work on which this form has been used, Mr. Park states that the cost of setting up the forms and of mixing and placing the concrete for the steps averages from 6 cts. to 10 cts. per lin. ft. of step.

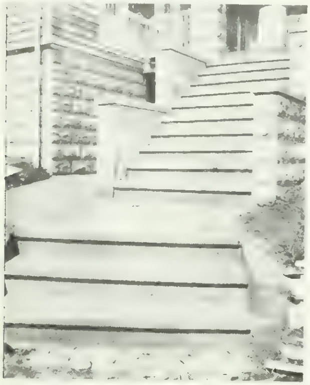


Fig. 4—The Completed Concrete Steps

The accompanying illustrations show different stages in step construction. In Fig. 2 the rock and earth fill is in place; in Fig. 3 the forms have been placed and the concrete poured. Fig. 4 shows the completed flight of steps. The riser boards used in this case were formed so as to provide a nosing as shown.

* * *

A Cantilever-Swung Builder's Derrick

Hand derricks are coming into very general use on building work where it is necessary to raise reinforcing steel, centering, window frames, etc., to upper floors. Sasgen Bros., Chicago, have been building hand derricks for some time, and the accompanying illustration shows a new model in which the boom is carried back over the head of the mast and used as a seat for the drum. The fittings in this machine are crucible and malleable steel. Either hand or engine power can be used.

When the derrick is hoisting, a hand lever on the lower collar at the mast prevents any swinging. When the load is up, the collar is released, and the rear extension permits an easily controlled horizontal swing.

The derrick is 8′ high, with a boom swing of 10′. Using the cable triple, the capacity of the derrick is 2,500 lbs. The derrick is equipped with 150′ of 5/16-in. steel cable. When power is used, the cable feeds over a sheave at the top of the mast, down the mast, and over a sheave at the bottom.

* * *

A New Bar-Bender

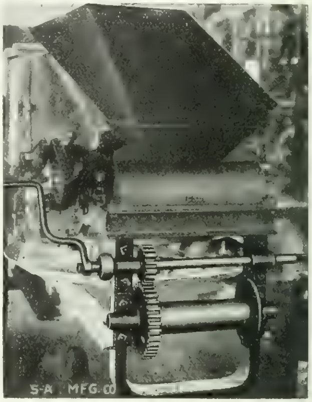
The accompanying illustration shows a hand power bending machine that was originally designed and built by the W. H. Anderson Tool and Supply Co., Detroit, for its own use. The machine will bend bars up to 1¼″ and can be used to handle U-bars and other special shapes. Cast-iron dies can be easily furnished for any special shape. Following its own successful use of this equipment the W. H. Anderson Tool and Supply Co. has now placed this machine on the market.

* * *

The Asbestos Protected Metal Co., Beaver Falls, Pa., has acquired an additional tract of land adjoining its present main plant at Beaver Falls. A special steel treating plant, a storage building, and a new one-story steel and concrete factory for the manufacture of architectural roofing tiles and asbestos shingles have been planned to take care of the rapidly increasing business of the company. Special machinery of the company's own design and manufacture will be installed.

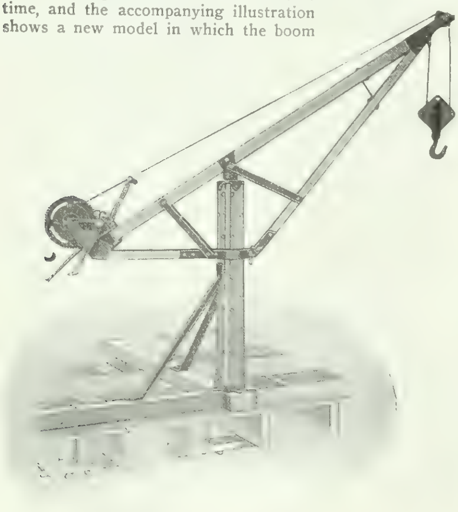
A Hand Winch on a Mixer

The advantage of delivering concrete directly into the forms is a strong feature of the lighter continuous mixers. In pouring house foundations, the mixer may work from opposite corners and deliver a wet mixture directly into the forms with far less labor than by wheeling all the concrete from the mixer. By placing the aggregate and cement so that it may be shoveled directly into the mixer a very great saving is secured in placing the concrete. This method of operation may also be employed in laying sidewalks or curbing, in these cases moving the mixer as the work progresses.

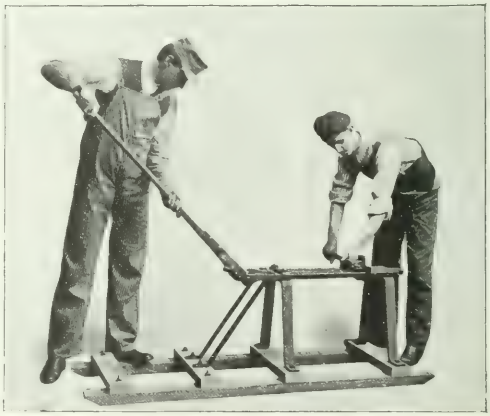


Detail View of Hand Winch on a Continuous Mixer

A difficulty frequently met in handling work in this way is that of moving the mixer over very rough or muddy ground. To overcome this, the Aurora Concrete Mixer Co., Aurora, Ill., equips its mixers with a geared hand winch on the front of the mixer frame. By using this winch with a rope fastened to a dead-



Cantilever-Swung Derrick



View Showing Operation of the Anderson Bar Bender man, one may move the mixer over ground of practically any character. The light weight of this mixer does not ordinarily necessitate the use of this winch, but it is furnished with the machine where required.

* * *

D. and A. Post Mold Co. Moves into Larger Quarters

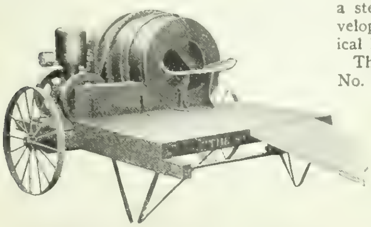
Concrete fence posts have come to stay. In every way they are better than timber posts and are meeting the warm endorsement not only of the great railway corporations, but of individual farmers. To meet a greatly increased demand for its product the D. & A. Post Mold Co., Three Rivers, Mich., has moved into a large four-story brick building which will be devoted entirely to the manufacture of its product. The D. & A. post mold, well known to Concrete-Cement Age readers, embodies a vibratory or shaking system for compacting the wet concrete.

* * *

A Small Batch Mixer

Easily portable power-driven concrete mixers offer many advantages. It is easier to move sand, aggregate and cement than wet concrete, and current practice indicates that many contractors are using lighter mixers and moving them more often. The accompanying illustration shows the "Standard Junior," a new model recently placed on the market by the Standard Scale and Supply Co., Chicago. This machine is mounted on two or four wheels and with or without power, gasoline or electric. The 4-wheel machine is mounted for side discharge, and is adapted to all regular work, while the 2-wheel mixer is built for rear discharge and is suitable for sidewalk and other special work.

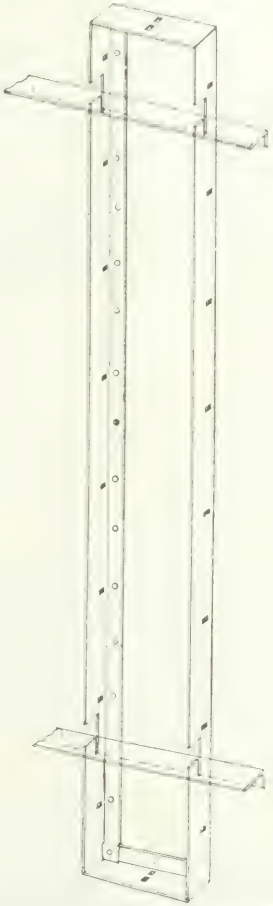
The low charging platform is about 2 ft. high and although portable with the outfit, can be very easily removed. The mixer can be charged directly from the piles by means of shovels, when desired. The large opening in the drum allows the inspection of the batch while mixing, thus assuring a uniform high grade concrete, impossible to secure by hand mixing. The "Standard Junior" mixers are equipped with semi-automatic discharge. This machine will, it is stated, mix twice the amount of concrete with half the labor that can be mixed by hand.



General View of the End Discharging "Standard Junior" Batch Mixer

Steel Wall Forms with Vertical Joints

As concrete construction advances, every effort is made to develop equipment and methods which will make for better and lower cost work. Efficient equipment forms the tools of the industry, and the development of the equipment for any industry is directly related to the advance of the industry itself. Steel is replacing wood for centering in concrete construction and the following notes and illustrations show a steel panel form which has been developed along new and somewhat radical lines.



Sketch Showing Detail of Standard Panel Form

The standard form unit is made of No. 10 ga. steel, 8′ long and 1′ wide. The essential feature of this system, which has been developed by the American Building Corp., N. Y. C., is that the unit panel *in place* is 8′ high, that is, one panel forms a mold for a section of wall 8′ high and 1′ wide. The panel is edged with 3-in. x 2-in. angle-iron.

Based on the use of this unit, it is general practice to center and cast at one operation the wall required for an entire story height. The panels are assembled, locked together by a wedge and clip, and held in alignment by a loose ledger angle, dropped into notches cut into the sides of the panels, as shown in the accompanying sketch. Openings and doors are provided for by placing plates between the sides of the molds, and projecting sills and belt courses are also cast integrally with the wall. This is done by different sets of clip holes in the angle sides, enabling such offsets to be easily and accurately cast. In finishing the cast story, the cornice, roof and walls can be cast at a single pouring.

* * *

Asbestone Flooring

Asbestone is a composition flooring material manufactured by, and placed under the supervision of Franklyn R. Muller & Co., Chicago. Calcined Grecian magnesite, imported, is used, incorporating about 50% of this material with the other ingredients. The hardening qualities are produced by the combination of the calcined magnesite and chloride of magnesia, of the proper specific gravity. The fillers and colors used in this flooring material are added in the proportion that will make the floor both elastic and durable.

Color designs can be incorporated by putting in a base and border of one color and a field of a second harmonious color. The joint will be hermetically sealed, and the job, when finished, produces a floor, or a floor, base and wainscoting that is in one piece.

The material is spread in a plastic state, ½″ thick, either over a wood or a concrete under-floor. Where spread over wood, the wood should be soft wood, which is reinforced with a light expanded metal. If laid over concrete, the top ¾″ should be of a good strong mix, equal to at least 1:3, with good sharp sand. The concrete should be rough finished with a float, and must be thoroughly dry and set before the composition is applied. The material in place, ½″ thick, weighs 3 lbs. per sq. ft.

After the floor is finished it is treated with a coat of oil and benzine, mixed 2:1, lightly applied, and a coat of highest grade liquid wax.

This material is used extensively in public buildings of all kinds; principally in corridors, toilets, lavatories, stair treads and risers, also sanitary cove base and wainscoting. In residences it is used on sun porches and in kitchens, vestibules, bath rooms, etc.

* * *

Reorganization of the Altoona Portland Cement Co. has been effected, with a capital of $1,200,000. The plant is at North Altoona, Kans. Incorporators are: Bert V. Howard, Kansas City, Mo.; T. A. Parker, Kansas City, Mo.; H. A. Butterfield, Kansas City, Mo.; G. B. Richardson, Altoona, Kans.; W. S. Willett, Altoona, Kans.; P. O. Nielson, North Altoona, Kans.

Metal Forms for Greenhouse Benches

The accompanying illustrations show forms for the construction of sectional concrete greene house benches and they also show the sections from the molds. These forms are manufactured by the Geo. M. Garland Co., Des Plaines, Ill. A bench, assembled, except that two of the side pieces are removed, is shown in Fig. 1 and concrete benches in use are shown in Fig. 2. The molds in which the bench parts are cast are made of cast iron smoothly finished so that the concrete is easily withdrawn. A semi-wet mix is used so it is possible to make many pieces from the same mold each day. Each piece is left on a wooden pallet to harden. The manufacturers say that two laborers can make about 125 corner posts in a day, about 100 bottom slabs, 100 side slabs and about 75 to 100 stringers. Forms for the corner posts are made in two heights, 17" and 25". The posts are tapered and have a 10-in. base. The manufacturers say that with Portland cement at $1.60 a barrel, making a cost of $2.00 for 1¼ barrels of cement and two laborers at $1.75 a day, 125 posts can be made at a cost of $5.50. This charges up nothing for sand and cinders or gravel. The green house man, while apt to have cinders, still might add considerable to the cost of these posts in purchasing materials and yet find them extremely economical. The bottom slabs are made with a core so that they are much lighter. They are 30" long and 8" wide. Molds for the stringers are so made that these units may be cast in almost any length under 5'. The manufacturers of the molds figure that these benches can be completed at a cost of 8c per sq. ft. which is about 3c per sq. ft. more than wooden greenhouse benches cost, and while the wooden benches are good for a comparatively short time, it is figured that the concrete benches will last indefinitely.

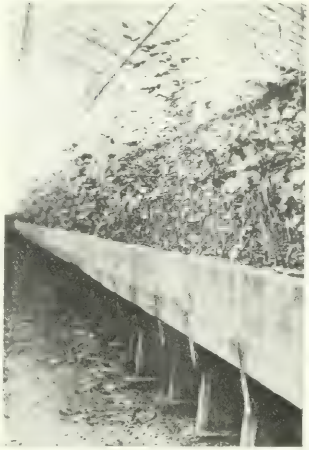


Fig. 2—Concrete Benches in Use

Book on Concrete Houses

The Universal Portland Cement Co., Chicago, is distributing a new book, "The Concrete House and Its Construction," published by the Assn. of Am. Port. Cem. Manfrs. It has 224 pp., 159 illustrations and is sold for $1.00 per copy. The index of chapters indicates its scope.

The advantages of concrete for house construction; architectural design and treatment of concrete houses; details of construction; operations in the field; calculations for determining the strength and design of reinforced concrete in house construction; calculating the bending moments for reinforced concrete beams and slabs, and the determination of size and reinforcement; tables for designing reinforced concrete construction and their use; concrete block houses.

* * *

A new concrete mixer, combining the features of both batch and continuous machines, is being manufactured by the New Method Machine Co., Toledo, O.

* * *

American Mixers in Brazil

The Cement Machinery Co., Jackson, Mich., has recently shipped to Rio Janiero, for government use, a continuous mixer, especially equipped with an electric motor drive to be used in building forts, and in construction work in and around government property. These mixers are especially equipped with 24-in. wheels in front and 36-in. wheels at the rear. Special back gears had to be provided to take care of mortar running at 1,200 r. p. m.

The Brazilian government has also purchased from the same company a 20-pocket brick machine and a face-down concrete block machine. They are using brick and block extensively.

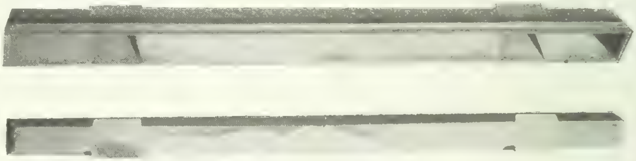


Fig. 5—Stringer and Mold

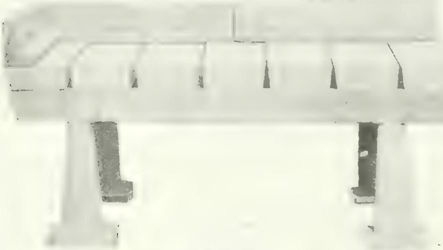


Fig. 1—Concrete Greenhouse Bench Assembled Except for Rails on a Side and an End

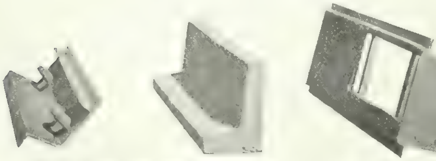


Fig. 3—Side Rail and Mold Pieces in Which It Was Cast

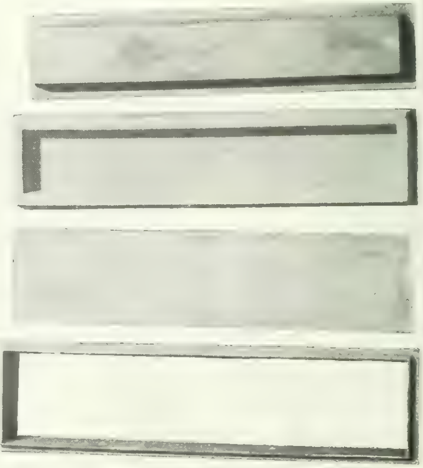
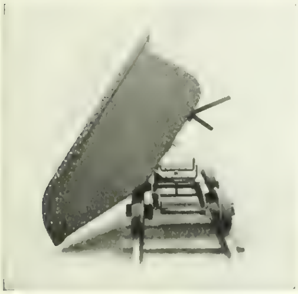


Fig. 4—Bottom Slabs and Slab Molds

A Rotary Dump Car

The use of a rotary dump car for handling concrete materials is recognized as a convenient and economical method. The accompanying illustration shows an improved model of the rotary dump car manufactured by the Ransome Concrete Mchy Co., Dunellen, N. J. This car will dump either side or endwise. It should be noted that it is nearly rectangular in shape, making it very suitable for measuring the charge accurately. It is particularly adapted to charging mixers, inasmuch as it is narrow and concentrates its load sufficiently to get into feed chute or fixed batch hopper. At the back of the car is a heavy and large handlebar for dumping. One of the objections to rotary dump cars heretofore has been their cracking under the hinges. In order to avoid this, this new car has been reinforced under the hinges with an angle iron. The cars have dust caps over the ends of axles which prevent grit from getting into the bearings, thus increasing the life of the roller bearing wheels. The wheel treads are 3″ wide, which is ample to keep the cars on the track, even though it is poorly laid, as temporary track usually is.

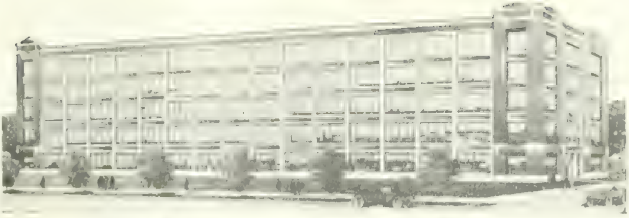


An Improved Model of Rotary Dump Car

An Example of Modern Factory Design

Gray & Davis, makers of the well-known automobile electric lighting and starting systems, are having designed, by Monks and Johnson, Engrs. and Archs., Boston, a most complete and modern factory building. The new building will be situated in Cambridge, on the Charles River parkway, near the Cottage Farm bridge and facing the Charles river and Boston. The owners, appreciating the importance of a structurs located so prominently, have given the engineers the opportunity of combining, as nearly as possible, architectural beauty with scientific factory design.

The present building is to be five stories high, 381′ 6″ long by 81′ 0″ wide, on the first floor and 61′ 0″ above that, and is designed to allow for future additions and a power house. It will be absolutely fireproof throughout, being constructed of reinforced concrete. The exterior will have a veneer of tapestry brick, giving a distinctive, unique and attractive appearance, and is so treated as to give a window area of nearly 65% of the wall area, which is about three times the window area of the old style factory building. The glass area is further increased by the use of steel sash.



A [illegible] Example of Modern Factory Design

There will be a large show room on the first floor, while the offices will be on the second floor, occupying the full width of the building for a length of 200′ 0″. The directors' room and the private office of Mr. Gray will be lined with a special design of tapestry brick, contain large fire places, and be fitted with every convenience. In the factory proper the ceiling will be painted in light tones to assist in light distribution. There are to be locker rooms on every floor, containing sanitary steel lockers, one for every employee. Electrical time clocks will be placed on every floor, and these will register on a master clock in the office. The latter also automatically rings bells throughout the factory at the starting and stopping times. Many other things which tend to increase the efficiency or convenience of the help and go to make model working conditions are sanitary drinking fountains, portable vacuum cleaners, electric drying ovens, compressed air cleaners, for cleaning out machines, etc. Electrical power will be used entirely, and will, eventually, be generated in the power plant to be erected later.

Tests of the Strength of Cement*

To many people it is, undoubtedly, a fact that any bag marked "Portland Cement" is just as good value as any other bag so marked, and also that—

(*a*) The cheapest cement is the most economical to use.

(*b*) Testing a cement with a "name" is unnecessary.

(*c*) The value of fine grinding is not considered, even if its advantages are known.

(*d*) The paste tensile 7 days test is quite sufficient guide to a cement's value as a "binding" material.

These tests were carried out to emphasize the need of testing all materials, and included in a comprehensive manner a careful investigation of 16 different brands of cement. The specimens were tested for tension, compression, and binding. Ten of the samples were furnished by cement manufacturers, four were purchased in the local markets, one sample was a German slag cement, and lastly a mixture was made of the first 10 samples shown in the accompanying table. This table shows the highest value instead of the average, and, to determine the relative value of the cements, all results were prorated to those for sample No. 5 which was the weakest all the way through and this relative value is expressed in the column marked "Value."

In this table it is of interest to compare the results from the "mixture" of the ten samples with the average of 10.

The author restricts his detailed comparison to Nos. 5, 6 and 7, and indicates in detail the various factors involved in the results shown.

Bending Test

The author states that while this is in a way a new form of test, yet it is one which could easily be carried out with the work and which would afford some indication of a cement's value, but like the paste tests it gives, the author says, no correct indication of the binding power. Hence prisms of mortar would have a greater value. A description of the apparatus used in this test follows:

Molds—A piece of teak 14″x14″x1½″ for the base, and seven teak bars 12″ x 1″ x 1″ placed 1″ apart and held by two end pieces notched to receive them and screwed to the base formed the mold.

Breaking Apparatus—An ordinary carpenter's horse was used, upon which was nailed a small piece of teak, rounded in both directions, for one support, and a loose piece similar in shape, but deeper and with a rounded base and resting in a notch in the top of the horse for the other support. The high points of the supports were placed exactly 10″ apart. Two inches to one side of the centre a yoke of steel wire was fixed to form the fulcrum for a lever, between which and the centre of the specimen was a small roller. From the end of this lever was hung a small tin pail into which lead shot was poured until the specimen broke. Ten times the weight of the shot plus the weight of the lever (balanced on the specimen) gave the breaking load, which agreed within 3 lbs. for the three specimens in each cement.

Total Values

The last two columns in this table give the values totaled and then reduced to No. 5 as unit. Here No. 7 in paste is over 3 times as strong as No. 5, while in mortar it is over 4½ times as strong. On the other hand, No. 6 is comparatively weaker in mortar than in paste, being 2½ times as strong in paste, but only twice as strong in mortar. There is no doubt that the sieve residue is the cause of this. It is evident that No. 6 is gamely struggling against poor grinding, although showing up splendidly in paste. That it is a first-class binder has been proved as later tests, with a better ground sample, showed.

---

*An abstract of a paper by H. C. Johnson, University College, Cork, Ireland, read before the Concrete Institute, London

Other tests were carried out in detail to determine the effect of varying percentages of water, and the structural strength of concretes made from these cements. The author's conclusions follow:

1. That a good strength in paste is no proper indication of a good strength in concrete.
2. That the best tests of a cement's value for reinforced concrete or similar work are—
    (*a*) Mortar compression cured in water,
    (*b*) Mortar compression cured in air,

and in addition to having to show a certain strength, any cement having a higher value in air than in water to be condemned.

3. That not less than 22% of water be allowed in gauging paste, and not less than 3% plus ¼ the percentage as used in the paste, in gauging mortar.
4. That the standard of values for cement to be used in reinforced concrete work be raised by 25%—not that a cement only just passing the British Standard Specification is to be condemned for average work, but in order that first-class cements only shall enter into reinforced concrete structures; engineers may then reasonably expect to be able, in the near future, to use 1,000 lbs. per sq. in. on concrete instead of 600 lbs.
5. That for a given expenditure on cement a first-class one will allow a saving, since there will be—
    (*a*) Less cement to pay carriage on,
    (*b*) Less cement to handle,
    (*c*) Less sacks to clean, tie up, and return,
    (*d*) With at least as strong a concrete.
6. That a given strength of concrete should be specified, instead of a given mix—which does not take into account the proper proportioning of aggregate—even if a cement of first quality is used.
7. That cement should be sold by volume instead of by weight, and in bags containing 1 cu. ft. to allow of quicker and easier handling. These bags should be made of paper for preference, this being the common practice in the United States. Among the advantages the author noted that paper bags have over canvas ones are—
    (*a*) No time is lost in shaking out the cement,
    (*b*) No cement is retained by the sacks,
    (*c*) There is no return freight on empties,
    (*d*) The packages are better looked after in storage, and
    (*e*) Cement is kept in better condition.

Motor Truck Performance

An interesting trailer haul was made when a frame for the door of the new vaults which are being put in the bank clearing house of New York City had to be moved through the streets of New York. This frame was made by the New York Safe & Lock Co., and was brought to New York on a lighter, which delivered it to pier 11, East river. It was placed upon a 4-wheel wagon, which itself, empty, weighed 16,400 lbs. The frame was 7′6″ wide, 9′0″ long and 3′6″ thick and weighed exactly 52,600 lbs. A LaFrance hydraulic truck was loaded with five steel plates for this vault, which in the aggregate weighed 12,100 lbs. The LaFrance truck itself weighs 4½ tons, so that the total load, including trailer and vault frame, to be moved was 90,100 lbs. The shortest way to deliver this load to its destination would have been through Wall St., but permission to use this thoroughfare was denied on the ground that the street paving would not support the load. Therefore, the truck had to proceed down Front St. to South Ferry and then on up to Whitehall St. to Bowling Green and up Broadway to Cedar St. Two horses were hitched to the pole of the truck, so as to control this pole and keep the trailer right. A grade of 4½% was encountered on Broadway at Bowling Green, just above Beaver St. The frame was placed upon timbers mounted on the truck and the load was so heavy that it crushed the timbers and the load had to be stopped and the frame jacked up and new timbers placed underneath. The only damage done was to one small manhole cover on Whitehall St., which was broken. In order to show its remarkable tractive effort, the truck was stopped with its load on the 4½% grade at Bowling Green and had no difficulty at all in starting again

We need and will pay 25 cents each (or extend subscription two months) for copies of the July and August, 1912, issues of CONCRETE-CEMENT AGE. We want only a limited number; so drop us a card saying you have them before you send them to us. Concrete-Cement Age Publishing Co., Detroit, Michigan.

Cement	Fineness: Sieves 76²	Fineness: Sieves 180²	Apparent Density	Specific Gravity	Bending [illegible]	Per Cent Water in Paste	Cement Paste: Tension 7 Days	Value	Tension 28 Days	Value	[illegible] 7 [illegible]	Value	[illegible]	Value	Per Cent Water in Mortar	Cement Mortar: Tension [illegible]	Value	[illegible]	Value	Compression 7 Days	Value	28 Days	Value	Total Values Based on No. 5 [illegible]: Paste	Mortar
			Lb. cu ft		Lb																				
1	1·05	9·70	84	3·094	49½	26	405	1·40	555	1·63	4,100	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	140	1·55	695	1·88	1,602	2·68	1·90	1·92
2	0·10	8·20	79	2·990	77½	27	520	1·80	590	1·74	1,940	[illegible]	[illegible]	[illegible]	[illegible]	16[illegible]	[illegible]	240	[illegible]	1,250	3·38	1,907	3·19	2·14	3·32
3 (local sale)	0·70	16·95	93	3·050	43	25	340	1·17	500	1·47	2,465	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1·66	150	[illegible]	459	1·24	1,173	1·96	1·36	1·6[illegible]
4	0·20	8·00	89	3·065	76	25	540	1·86	670	1·97	5,348	[illegible]	[illegible]	[illegible]	[illegible]	15[illegible]	[illegible]	275	[illegible]	1,206	3·26	2,195	3·68	2·45	[illegible]
5 (local sale)	2·55	19·80	83	2·940	39	25	290	1·00	340	1·00	1,872	[illegible]	[illegible]	[illegible]	[illegible]	45	[illegible]	[illegible]	1·00	370	1·00	598	1·00	1·00	1·00
6	3·20	35·70	107	3·030	64½	25	600	2·07	840	2·47	5,140	[illegible]	[illegible]	[illegible]	[illegible]	70	[illegible]	180	[illegible]	671	1·82	1,554	2·60	2·58	[illegible]
7	0·05	5·60	83	3·065	92	24	660	2·28	710	[illegible]	7,060	3·77	12,620	[illegible]	[illegible]	[illegible]	4·45	[illegible]	[illegible]	2,108	5·70	[illegible]	4·58	3·12	[illegible]
8	0·01	13·80	90	3·030	48	28	325	1·12	435	[illegible]	2,735	[illegible]	4,300	[illegible]	[illegible]	11[illegible]	[illegible]	175	1·94	[illegible]	2·15	1,269	2·12	1·37	2·17
9	0·07	11·90	94	3·130	61½	24	500	1·72	570	1·68	[illegible]	[illegible]	6,530	[illegible]	[illegible]	[illegible]	[illegible]	165	[illegible]	790	2·14	1,255	2·10	1·09	2·18
10	0·12	9·55	94	3·100	74	24	615	2·12	620	[illegible]	4,735	[illegible]	6,250	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1,460	[illegible]	2,085	3·49	2·15	4·20
Average (1st 10)	·		—	—	62½	25½	480		588	—	4,295		[illegible]		12	13[illegible]		202		[illegible]		1,638		—	·
Mixture (1st [illegible])	—		—	—	73	27	535	1·85	620	[illegible]	4,800	[illegible]	6,105	[illegible]		125	[illegible]	[illegible]	2·44	1,075	[illegible]	1,515	2·54	2·08	2·67
11 (local sale)	1·55	[illegible]	88	3·030	39	26	315	[illegible]	385	[illegible]	2,550	[illegible]	3,640	[illegible]	12	60	[illegible]	105	[illegible]	486	1·32	737	1·23	1·20	1·26
12	0·01	3·40	85		84½	27	525	1·81	[illegible]	1·56	6,696	[illegible]	8,312	[illegible]	10	200	4·45	225	2·50	1,723	4·67	2,897	4·85	2·45	4·12
13 (slag cement)	0·01	3·80	80		70	27	595	[illegible]	545	1·60	4,300	[illegible]	[illegible]	2·41		190	[illegible]	295	[illegible]	1,370	3·71	2,350	3·93	2·09	3·79
14	0·75	14·60	85	—	58	25	475	1·64	535	1·57	3,710	[illegible]	6,476	2·20	[illegible]	120	2·67	190	2·11	715	1·93	1,400	2·34	1·85	2·26
15 (local sale)	—			—	41	25	315	1·07	495	1·46	2,285	1·22	3,760	1·28	[illegible]	85	[illegible]	150	[illegible]	530	1·43	870	1·46	1·26	1·61
Average (of 15)	—		—		61	25½	467	—	558	—	4,166		6,660	—	11½	13[illegible]	-	200	–	[illegible]	—	1,642	—	—	—

TABLE I. A SUMMARY OF THE RESULTS OF TESTS MADE AT UNIVERSITY COLLEGE, CORK, ON SIXTEEN SAMPLES OF CONCRETE
The column headed "Value" gives the result prorated to analogous results found for Sample No. 5

Concrete-Cement Age

Vol. II JUNE, 1913 No. 6

Editorials

FURTHER evidence of the fact that concrete architecture may be and should be (for inherent physical reasons) essentially different, and that for all this difference from the architecture of the materials with which we have been more familiar, it can still be excellent and beautiful, is discovered in the illustrations which accompany the leading article in this issue. Here the architect has forsaken all that cannot properly be expressed in concrete and has made concrete expressive in its own admirable way.

* * *

THE PARIS municipal housing enterprise (an account of it appears elsewhere in this issue), with its many comforts and conveniences, its high standards of sanitation and protection to human life, could not have been projected, much less seriously entered upon, were it not for reinforced concrete. The economical use of this material in construction may make it possible for Paris to build the first of a series of buildings which will make the workman thoroughly comfortable in his home, and require from him a minimum rent only.

* * *

ANOTHER STEP toward standardization in concrete pavement construction is recorded in this issue in a report of tests made on pavement slabs of various concrete mixtures. Everyone who is considering the use of concrete paving—and the number of those so considering it are constantly increasing, should by all means note the conclusions drawn from these tests.

* * *

AS A NATION we should now be listening to those men, who, like the prophets of old are crying out against our appalling fire waste, which is, in this day and age, a national sin. We, as a people, are slowly realizing a great truth. We must build fireproof structures.

There are so many reasons why we *should* build these, and these alone, that it is rather interesting to examine the matter in detail, and see what are the reasons that we *do not* build in this way more generally. The *"shoulds"* must now be over-balanced by the *"won'ts,"* for fireproof construction is on the steady increase, but as we see with keen regret combustible structures still being erected, there must be active in our national consciousness many reasons why fireproof construction does not, to many individuals, make the winning appeal.

The most important reason is probably the higher first cost that stares the prospective builder in the face. This is not only the most important reason, but it is undoubtedly the fundamental one, of which all other reasons are derivatives. Being influenced by the idea of higher first cost in considering the comparative value of fireproof or combustible construction is like being scared by a Jack-o'-Lantern. It is a bugaboo, a fake. When a builder builds, he is building we hope, not only for today, but for many days and many years to come, and what is apparently saved in first cost is paid many times over, in maintenance and repairs. His entire investment is always menaced by the fire demon.

It is this question of fire loss that we want now to emphasize especially. Our American cities, practically built or re-built within the last 50 years, have been designed and constructed under the protection of exceedingly efficient fire departments. The development of fire-fighting methods and fire-trap construction have played see-saw with each other for half a century. Fire-trap construction demanded protection and efficient protection encouraged fire-trap construction.

It would probably sound very radical to say that we might be better off if we had not developed our fire-fighting departments. Yet this is to a certain extent true, for if every individual builder in the average American city had to face for himself the necessity of building fireproof structures, we, as a nation, would not have to face the damning record of our fire loss, our national shame.

The fire waste is a disease in our body national, a malady demanding prophylactic treatment of the most rigorous kind; viewed in this light, our fire departments become, as it were, the tonic furnishing false strength, the patent cureall for the results of short-sighted and irresponsible construction of combustible buildings. An ounce of prevention is worth a pound of cure. When a building is being designed, emphasis placed on fireproofing design and construction features, that is, fire prevention, are worth any amount of cure. In the past and at present, our communities have been, and are, ready to furnish cure, in the shape of fire departments, in an unlimited quantity. The average home builder, lulled into security by the paternal protection of fire departments, does not use the ounce of prevention. The cost of maintaining fire departments, overlooked in the total of the annual budget, does not come home with any emphasis to each individual builder, but he pays just the same.

If there were no fire departments, would not the average builder see in better focus the real, the permanent advantages of fireproof construction? Would not the average builder feel more keenly his individual responsibility, to himself and to his community, if a building *had to be fireproof* or burn?

In this discussion the question of farm buildings or those at present not under public fire protection has not been considered, for many other factors are involved there. For the average building operation, however, in any of our American municipalities, it is interesting to consider what effect, either direct or indirect, our American fire-fighting service has had on the development of fireproof construction. It certainly has not encouraged it, and inadvertently, it has probably, to some extent, acted as a discouragement, lulling the prospective builder into a sense of false security, a wrong to himself, and to his community.

A logical conclusion to such a premise would be that if the builder of a combustible structure could be made the only one to pay for his fire protection, the up-keep of efficient fire departments, some good would be accomplished. Bring home the responsibility to the individual in the shape of a dollar and cents cost, and fire-trap construction would not look so attractively cheap. The same end could be served by making the owner of a fireproof structure exempt from certain taxes. To illustrate the absurdity of conditions at present, suppose A and B own adjoining lots; A builds a fireproof cottage and B a frame structure. They each pay about the same taxes, and A has to pay as much as B for the support of the fire department, although A himself needs no fire department. His need is protection against a spread of fire from B's house, and even that can do him little material damage if he has built intelligently. Why should a fireproof structure which is in itself neither a fire breeder nor a fire feeder, but in many cases is even a fire retarder, a fire wall, contribute to the support of a fire department?

We have, then, the premise that the first cost of fireproof construction is in many ways a hindrance to its more extended use. We find that so far as taxes in general and the support of fire departments in particular are concerned, no exception, or rather exemption, is made for fireproof, for fire-resisting buildings. Right here the effective preventive, the rigorous prophylaxis, should be applied which would eliminate this national disease, and for the average builder, bring into better focus real values in modern construction.

* * *

A Brick Paper Reaches Height of Absurdity

In the Mar., 1913, issue (p. 106) attention was called to a recent effort of the brick and clay people to influence the Ford Motor Co., Detroit, to use brick in a new factory being planned at Seattle, Wn.

A late number of our contemporary, the *Brick and Clay Record,* capped the climax of absurdity in discussing the results of its frantic appeal to its readers. It is sufficient at this time to call attention to a few statements in the issue of *Brick and Clay Record* for Feb. 15, 1913. After outlining the situation about as covered in our March number, it says:

> "While the thousands of letters that the Ford Company received from the clayworkers of the country did not cause it to change its plans for the Seattle factory it did prove:
>
> That clay manufacturers *can* get together if they want to.
>
> That the way to *do* a thing is to *do* it.
>
> That the time to win people to brick is not after they have made plans to build, but *before* they decide to build.
>
> That never was the necessity for some sort of an association or organization of national scope, to which appeals of this nature can be addressed, better shown than in this instance."

Another paragraph later on is as follows:

> "The outside walls of the structure are to be of concrete but inasmuch as the plans call for practically an all-window construction, the quantity of this material used will be comparatively small."

Comment on this is needless, it is so apparently absurd. As to the "thousands of letters" received by the Ford Co., the number actually received was measured by hundreds, and not a very large fraction either, of a single thousand. The discussion of the situation closing with the following paragraph:

> "Mr. Graham was in Detroit at the time and telegraphed that he was coming to Chicago on first train to hear what arguments could be given him. Mr. Graham reached Chicago Jan. 29 and was met by members of the Chicago Face Brick Assoc. and representatives of this journal. His explanation of the plans proposed for the Seattle factory put a different light on the situation. He explained that neither himself nor the Ford Co. was partial to concrete, and that it was their intention to use clay products wherever they were considered by engineering experts to be the best."

As bearing directly on this question, the following letter to CONCRETE-CEMENT AGE from John Graham, supervising architect of the Ford Motor Co., is of interest. We have Mr. Graham's permission to quote it in full, as follows:

> "Replying to yours of the 14th (Feb.), would say that the Ford Motor Co.'s new buildings will be of reinforced concrete construction, veneered with red pressed brick on the exterior.
>
> On Jan. 25th, when in Detroit, I received the following telegram:—
>
> John Graham,
> Chicago, Ill., Jan. 25, 1913.
> c/o Ford Motor Co.
> Detroit, Michigan.
>
> Are you willing to be shown that brick is better for your Seattle factory than concrete? We have the goods—have you the time and inclination? Wire answer our expense.
>
> Brick & Clay Record
>
> I replied that I would be in Chicago the following day and would be very glad to be shown.
>
> A gentleman representing the *Brick and Clay Record* met me there and requested me to come with him and interview some other individuals who would give me this valuable information and who I found to be brick manufacturers. Having no time to wander over Chicago being introduced to brick manufacturers I declined this invitation. The gentleman who met me having no information himself and nothing further to offer, our interview ended.
>
> That is all I know about the matter, excepting that I have seen a copy of a silly bulletin issued by the *Brick and Clay Record.*
>
> I have no interest whatever in the fight between brick and concrete, using both materials as occasion arises, but I am inclined to agree with your comment upon this em-

anation of the *Brick and Clay Record* as 'futile piffle.'

Yours very truly,
FORD MOTOR COMPANY,
John Graham,
Supervising Architect."

There is little more to be said except that we believe in organized effort, and we would welcome any well directed organization among our friends, the brick and clay people. Any effort toward organizing, however, must be well directed or it is wasted.

* * *

Oxy-Chloride Cement Formulas

An interesting summary of the state of the art in the manufacture of oxy-chloride cement was presented in the Apr., 1913, issue in the communication from W. C. Edwards, Jr., published under Correspondence. The article, while devoted to a description of the process in the direction named, very properly is headed not "process" but "formulas." The manufacture of these oxy-chloride cements has been known to scientists for many years, being first brought to the attention of the scientific world by the work of Stanislas Sorel, a French Engineer, who in 1866 took out a patent on the composition. Since that time various and many have been the formulas advanced for the manufacture of artificial stone from oxy-chloride compistion, and many have been the failures. There is no doubt that much excellent material for inside work has been produced, but this has been more than offset by the many failures where the material has been used for exterior purposes. In the formation of companies and the enlistment of capital oxy-chloride formulas have been most successful. For the production of good work and the foundations of fortunes their success has not been so well-marked. One of the reasons possibly, for failure, relates a little to the well-known case of the failure of the St. Nazaire bridge in France, where overburnt magnesia in the cement is alleged to have caused the collapse of the bridge; and possibly in the oxy-chloride cements similar results may be due to the fact that the commercial chloride of magnesium is, as the writer already referred to says, "a waste or by-product for which no guarantee can be had that it is pure" nor could any be obtained that it is not overburnt. It is doubtless owing to the difficulty of always securing the chemical compounds in proper condition that many of these formulas for artificial stone have failed to give results, and one of the saddest cases occurred in Philadelphia, where many years ago a corporation, operating carefully and under scientific management, was finally forced to abandon operations owing to the failure of columns, window-sills, door-jambs and other outdoor work produced in the most beautiful colors and forms.

Mr. Edwards is quite right in stating that success in laying good floors with the material can be obtained only by absolute supervision and knowledge of the work and the materials and its use in interior floors or under other similar conditions.

Tying Concrete Around I-Beams

When concrete is poured around an I-beam, it is usually necessary to wrap the I-beam with mesh or wire of some kind to tie the concrete below the bottom flange up into the main body of the concrete alongside the web of the beam. The point of weakness is the relatively small, the width of concrete between the edges of the bottom flange and the outside of the concrete beam. The greater the depth of concrete used below the bottom flange for fireproofing, the greater the strain on this section. In practically all work, steps are taken to tie this bottom portion up into the web as noted above. Beams are usually wrapped with wire mesh, expanded metal, chicken wire, or single strands of wire.

On some work which recently came to our attention we watched two men, straddling a beam, slowly but surely wrapping it spirally with a single strand of wire. The operation appeared to be slow and expensive, and from an engineering standpoint did not seem to be so effective as other methods which would have distributed the wire to better purpose. Single strands of wire, wrapped tightly around an I-beam, do not accomplish in an economical way the intended purpose of holding the bottom section in place. This is apparent to the most casual observer.

In the Information and Consultation department for February, this problem will be discussed, and CONCRETE-CEMENT AGE would be glad to hear from any readers who have developed field details making for better construction.

* * *

How to Sell Clay Tile in Iowa is the Question

Calls for help issue with the regularity of "Old Faithful" from the throats of the clay brick press. Just now the industry is all stirred up over the fact that a district in Hardin Co., Ia., is in the market for 3 miles of 39-in. and 42-in. drain tile—and the job is going begging because the clay men cannot fill it. In the language of the unknown writer, there is "H—l to pay, and no pitch hot!"

Our greatly esteemed contemporary, representing our sister industry, is very much disturbed at the outlook. Its pages shriek and moan with pain, adding volume to the cry for help from the brethren in Hardin Co., Ia. Sample moan—"Iowa has been the battle ground for the cement people for some time, but the clay-workers of that state have combated them successfully and today reign supreme in the drain tile business. Victory, however, in getting this three-mile drainage contract will give the cement people an opening which they will not be likely to overlook."

The remedy suggested by our friend is that "every manufacturer of this size drain tile get in touch with Mr. Keeler[*] at once by telegraph and offer whatever aid possible under the conditions existing."

Assurances of sympathy and support take this form: "The stake at issue is more to the clayworkers than the dollars and cents' end of the deal. It means that the courageous clayworkers of Iowa, who have been putting up such a manly fight against the cement interests, will be given the support of the industry as a whole and that when the cry for help comes it is not passed unheeded by those who have every reason to be vitally interested."

In connection with the "support of the industry as a whole," the following naive statement is refreshing.

"It is to be regretted that the organization referred to in an editorial in this issue and also which was referred to in the last two previous issues, is not in existence."

This organization mentioned is one which the clay men are trying to form, but have not yet succeeded in bringing about. It takes something more than an organization to push a material; it requires a material that is superior to others. Concrete men have no commercial organization, and probably never will have. Talk about the "support of the industry as a whole" is a good deal like pulling the trigger of an empty gun.

* * *

A Timber Saw on Building Work

Probably from two to five feet, board measure, of lumber are required as centering for every superficial square foot of concrete poured.

This means that in erecting the average building several thousand feet of lumber has to be cut up, erected, built into panels and assembled into place. An entire building in form work is practically built before the concrete is poured. When one stops to realize to what an extent lumber is used in concrete construction and that the cost of the centering, lumber and lumber labor, is the biggest single item entering into concrete construction, it is readily apparent what a real and pressing need the small, self-contained, portable saw-rigs have met.

Going back to the days when the small saw-rigs were not available for the average builder, we find that more than one "kink" was used to lessen the cost of centering work; and one especially to lower the cost of sawing comes to mind. When panels are used, either for floor or wall work, the centering usually requires a considerable number of boards of the same length. Instead of sawing these one at a time with a hand saw, a dozen or more of them, on the work in question, were stacked neatly, one above the other, across a couple of saw horses and cleated together with a couple of diagonal cleats at either edge. They were, of course, made even at one end and the cut laid out with a square. The stack of boards, practically a big 12" x 12" timber, was actually cut by a couple of laborers or a handy man and a laborer with a 6-ft. cross-cut timber saw. This saved money and made for effective work. The saving over individual hand saw work was considerable.

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[*] B. C. Keeler, Sec. Mason City Brick and Tile Co., Mason City, Ia.

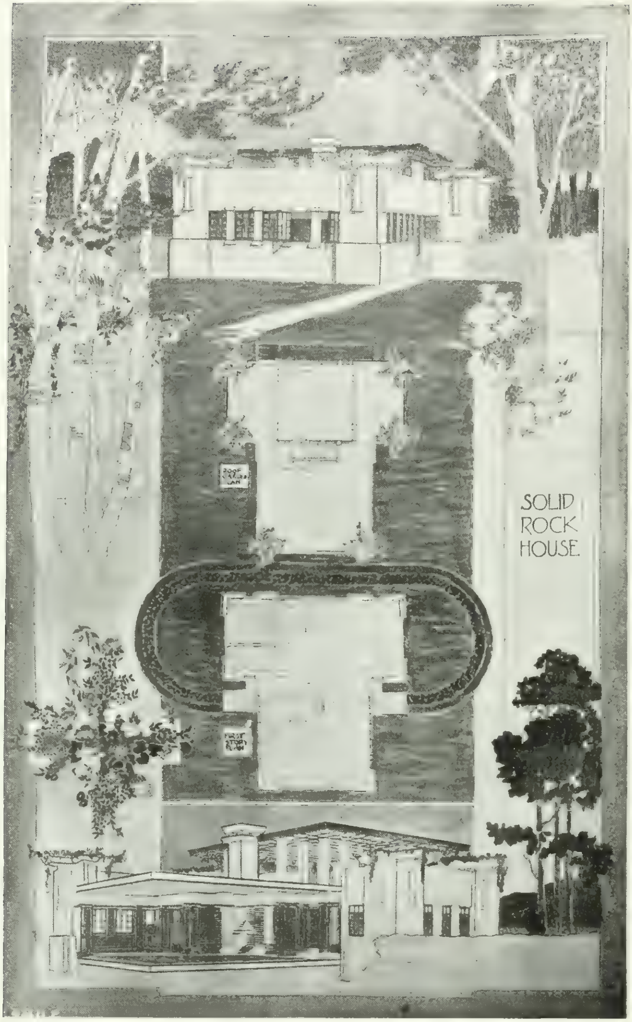
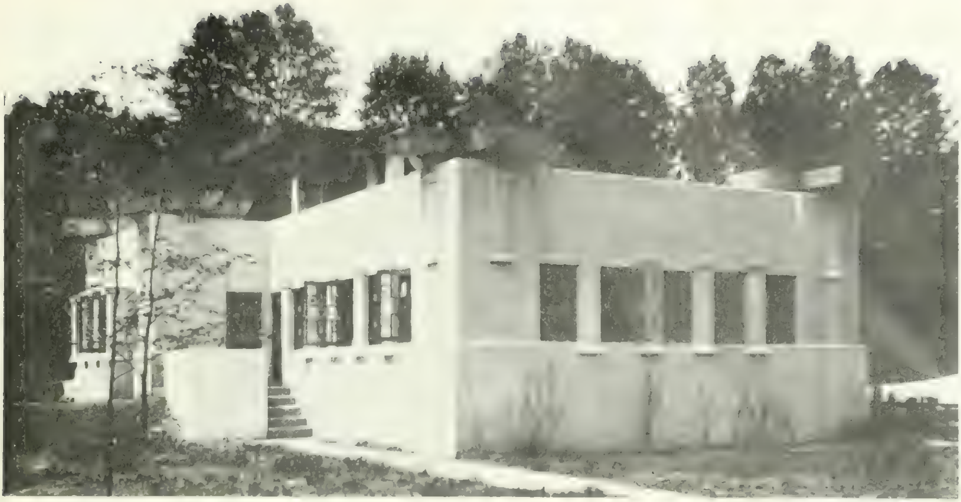


Fig. 1—A Reproduction of the Architect's Drawings for a Concrete Home of Original Design

The perspective is shown at the top; below this is the plan of the roof showing the covered veranda surrounded by a roof-garden; the first-floor plan shows the big living room in front, the entrance at the right, and the three chambers at the rear. Below is shown a cut-away perspective



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A Concrete Home of Unique Design

Dwelling in Which Concrete Has Been Used as No Other Material Could be Used

True art in architecture means more than a good design, for, in the bigger, broader sense, the structure, whatever it may be, must fit into, must be an integral part of its surroundings. The home of the average man, placed on the average lot, is the most important element in making our communities attractive and it is essential that in its relation to its surroundings, in its natural setting as it were, the average home shall be artistically placed.

In discussing this in a recent issue of the *Quarterly* of the Cook Co. (Ill.) Real Estate Board, Walter Burley Griffin, architect, Chicago, states that the very littleness and multiplicity of the units of this character that go to make up the effect, necessitate the greatest care in keeping each modestly unobtrusive in itself. Everything possible must be done, he says, to avert the disaster of monotonous, staccato repetition of self-sufficient pettiness on the one hand, or on the other, the confusion from rival efforts of each to distract the attention from the others and to attract it to itself, after the manner of the old-time hackmen of rival hotels at the station, or of the vulgar, intermittent flashing signs of a "Great White Way."

This means that the type of individual detached residence structures that will make the country suburb restful must tend toward subordinating itself to the fullest extent possible to the native beauty and verdure which its invasion on other terms utterly destroys.

The accompanying photographs illustrate a residence recently built in Essex Rd., Kenilworth, a suburb of Chicago, for E. L. Springer, a Chicago real estate man. In this case, the block frontage was made up of wood and glade of especial attractiveness which had not been previously disturbed. This house was the first step in an attempt to preserve the natural characteristics of these features without reducing the proportion of buildings to grounds that real estate conditions in the community require.

Concrete the Material to Use

A single material and a single treatment will serve best to harmonize the structure and its setting, and, as the material which needs least paraphernalia of protective features or connective expedients, the one nearest and most resembling nature's solid rock, of itself withstanding the storms and capable of supporting a bower of vine, shrub and flower, monolithic concrete, was adopted.

For satisfactory design in this material, as in any other, the possibilities of its nature must be sought directly and developed accordingly, avoiding irrelevancies and superfluities. Concrete may be assumed to demand a simple way of construction, with repeated use of the same molds and with large masses contrasting with plastic decorative elements. In the development of the design illustrated herewith, every dimension, so far as possible, has been a multiple of 4 ft. This made for economical form work.

Walls accentuated with projecting overhanging vine-garden features, and a concrete roof that will support grass and flower plots are developed into practically a terrace garden, surrounding a second story veranda, helping to afford to that necessary adjunct the maximum enjoyment by day, in its airy station overlooking in the four directions and catching the slightest breeze. At night, such a veranda offers an ideal resting place, due to its isolation and privacy from the remainder of the house, as well as the grounds.

General Arrangement

In the house illustrated, the rooms are all on one floor, giving the advantage of a flat for ease of housekeeping. The stairway and hall are so arranged as to give independence of access to the various departments—living rooms, kitchen, sleeping quarters; the living room and the dining room are thrown well together to give as much feeling of spaciousness as possible with the limited dimensions. The whole of the flat roof is utilized. The stairway is so placed as to make the roof accessible from out-of-doors or from any of the departments below without passing through any other, between the two casings provided for it, one important isolated room can be while by the shifting of one hall door transformed from a retired bed chamber into a reception room, library or office at the entrance. This room is

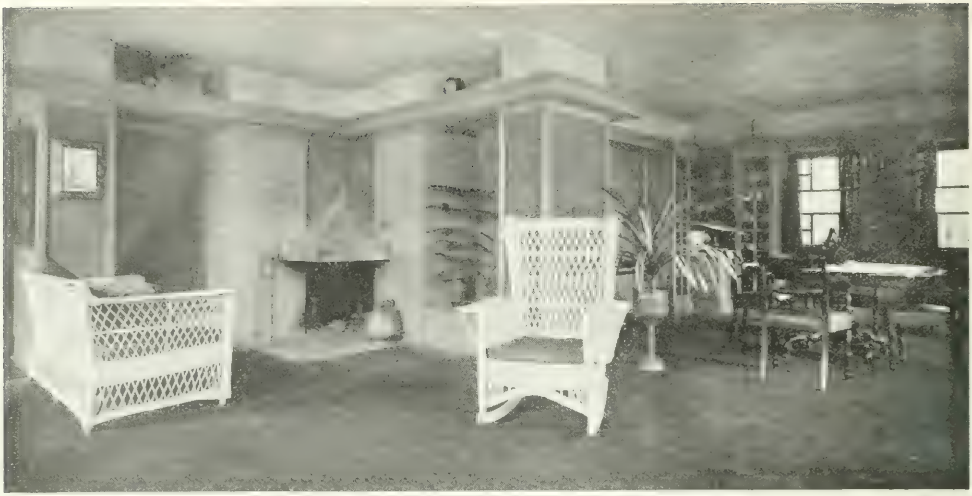

Fig. 3—The Dining Room and the Living Room, with the Corner Fireplace

shown at the right in Fig. 1. By a somewhat similar change at the rear hall a maid's room can be made to accommodate part of the family. These varied adaptations are especially important for investment houses where exact family needs can least of all be specified.

Interest in Such Construction

While this residence was under construction, there was no lack of keen interest and delight in such a straightforward attempt at the solution of an architectural problem. A procession of people visited the building work, individuals frequently returning week after week to watch its various stages of progress. It seems also to be the fact that such a house built for sale can be disposed of with facility. The residence illustrated was sold long before completed, while still crude for lack of all those features which add so much to the grace of a finished structure.

The walls were cast in wood forms and rough-cast on the exterior with white cement mortar. The flat roof is concrete.

The unfortunate conception that we can give style to our buildings by copying motives developed in former times has had a most deadening influence on our builders and has resulted in buildings so lacking in interest that we have curiously been led to believe that our people are lacking in an appreciation of art. The contrary is the case. The refusal of people to be interested in the meaningless, borrowed trappings of former civilizations in an effort to pretend quality and culture, shows accuracy of judgment and a true sense of the beautiful, for *art consists only in doing well what needs to be done.*

Special Concrete Block for Corn Cribs

An interesting and notably satisfactory corncrib is shown in Fig. 1. This was built by Charles Griesemer, Hopedale, Ill. It cost, complete, $650, not counting anything for Mr. Griesemer's labor, and he figures the time he personally put on the work at about $100. The crib is built of concrete block 24″ long, 10″ high and 8″ thick. Extending through these block the 8-in. way are air-spaces giving direct communication through the outside to the inside of the crib. These air-spaces are approximately 6″ by 1″ in area, and 8″ long, which is the thickness of the block. Fig. 2 shows the mold in which these block were made. The mold was designed and built by Mr. Griesemer, using 2-in. lumber. It is hinged at three corners and fastened at the other corner by a hinged hasp. The hollow spaces are made by boards about 1″ x 6″ in section, a little longer than the thickness of the block mold, so they project on each side. After the concrete is tamped into the block, above, around and below these cores, the cores are removed. The hasp is unfastened, and the sides of the block then swing out on their hinges, leaving the block on the pallet. There are seven of the cores in each block. The concrete for the block was made

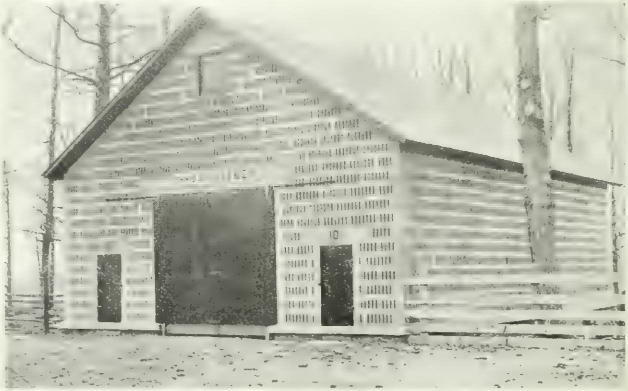

Fig. 1—Corn Crib Built of Special Concrete Block

1 part Portland cement to 5 parts pit-run gravel, and two employees of Mr. Griesemer were able to make 80 to 90 block a day. Eighty block required 5 bbls. of cement and 4 yds. of gravel. The corn-crib is built double, with a driveway in the center, and each of the twin cribs is 10′ wide by 40′ long and 14′ to the eaves. The driveway is 10′ wide, with additional storage space above it. The roof at the peak is 25′ high. The capacity of each one of the cribs up to the level of the eaves is 1,800 bus. of ear corn, but by use of the elevator with which the place is equipped, more room is made available, giving a total capacity for the storage of 5,000 bus. of corn. The structure stands on a 10-in. concrete foundation, 3′ into the ground. In the center of each crib, below the floor level, is a space between two concrete walls, which are placed 22″ apart, for a drag belt conveyor. Outside of these two walls and between them and the foundation walls, a gravel fill was put in and a 5-in. concrete floor on top of it. The floor slab extends 5″ outside the foundation. This creates what is in fact a watertable and prevents the entrance of vermin.

M. R. Feret, head of the Laboratoire des Ponts et Chaussées, Boulogne-sur-Mer, France, in his book on reinforced concrete, states that the drier mortar is made and the more it is tamped, the higher is its resistance, other things being equal, and on the other hand its bond to metal increases with the amount of water used in the mixture.

Victor Bentner has been appointed receiver for the Lumberman's Cement and Brick Co., at Carlisle, Kans. He was formerly manager of the plant.

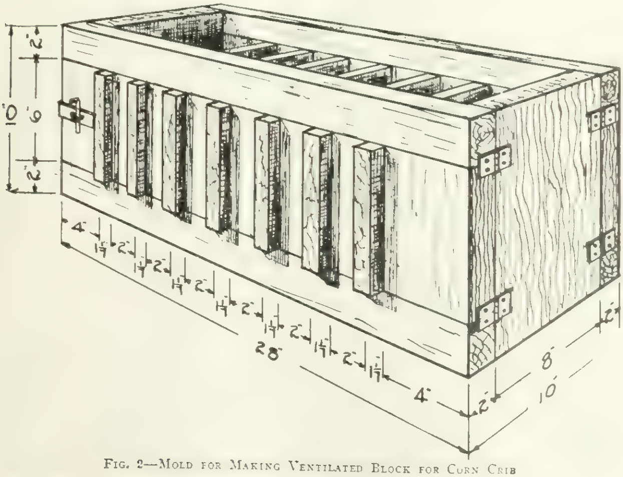

Fig. 2—Mold for Making Ventilated Block for Corn Crib

Lining Ditches with Reinforced Concrete

The prevention of seepage is an important factor in irrigation work, and in a report to the Hawaiian Sugar Planters' Assn. for the year ending Sept. 30, 1912, H. B. Penhallow, Paunene, Maui, chairman of the committee on cultivation, describes a method of lining irrigation ditches with expanded metal and cement mortar applied with the "Cement Gun."[1] The following paragraphs describing the operation in detail are quoted from a letter to Mr. Penhallow from A. W. Collins, C. E., of the Maui Agricultural Co., and are part of the report referred to above. For the photographs illustrating the work, we are indebted to A. E. Lee, of the General Cement Products Co., N. Y. C. The letter is dated Nov. 1, 1912, and is in part, as follows:

The increasing value of water in various sections of the country in the last few years has led to many experiments in ditch linings, by both government and private capital. The prevailing idea has been to obtain a lining permanent and at the same time cheap enough to enable people with limited capital to do work otherwise prohibitive. Without doubt a 4-in. to 6-in. concrete lining is the best, but the cost is high. Rubble wall set in a lime mortar has been tried with little reduction in cost, even getting lime at 75 cts. per bbl. Oil has been used in some sections, mostly in California, but this stops only a part of the seepage and would not be practicable for this country. There have been many plastered ditches, but results have shown them in the main temporary. Water gets in behind and soon causes the lining to crack off. This has been well illustrated on various ditches in the islands.

As far as I know the first experiments with a cement plaster lining, reinforced with chicken wire, were made on the Hamakua ditch, Hawaii. A large part of that ditch was lined this way, and at the present time the work is standing up so well that it seems safe to call it an ideal lining. One big item is the elimination of all form work, which makes progress very slow and is expensive. The chicken wire is fastened on to the sides and the bottom with nails or staples made out of an ordinary fence wire. In some places in rocky sections this is a little difficult but there are always enough cracks in the rock to be able to fasten on in a few places. There are also places so uneven, as in shale or loose rock, that they require "mudding" before the wiring and plastering. The wiring and plastering should follow this before the mud has had time to dry out and crack.

The one difficulty is to get the plastering *done well.* With our ordinary island labor, constant supervision is necessary. It is very easy to shirk the work, where the men are at all anxious to make a showing, by insufficient troweling. The mortar has a tendency to fall when first applied, and unless the worker is careful and experienced this causes a porous spot in the plaster. It is very difficult to make them rub it in thoroughly.

We became interested in the "Cement Gun" through its use by Capt. Edwards, in building construction at the different army posts near Honolulu.[2] It was thought to be ideal for ditch lining to overcome the inefficiency of hand work. Both the Maui Agricultural Co. and the H. C. & S. Co.[3] have a machine at the present writing, but thus far only the one belonging to the former has been used. * * * *

The "Cement Gun"[4] consists essentially of two vertically superimposed cylindrical chambers. Admission to the upper chamber is had through a swinging gate valve working against a rubber gasket. The lower chamber is separated from the upper by a similar gate, both being operated by means of a handle or lever on the outside. The discharge apparatus is located at the bottom of the lower chamber and consists of a feed wheel somewhat resembling a

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[1] The General Cement Products Co., N. Y. C.

[2] This work is described on p. 49, *Concrete,* Feb., 1912

[3] Hawaiian Commercial and Sugar Co., Paunene, Maui

[4] For previous references to the "Cement Gun" and its use, see
Cement Age, Apr., 1911, p. 198
Concrete, Apr., 1911, p. 49
Cement Age, Aug., 1911, p. 89
Cement Age, Oct., 1911, p. 161
Concrete, Feb., 1912, p. 49
Cement Age, May, 1912, p. 267

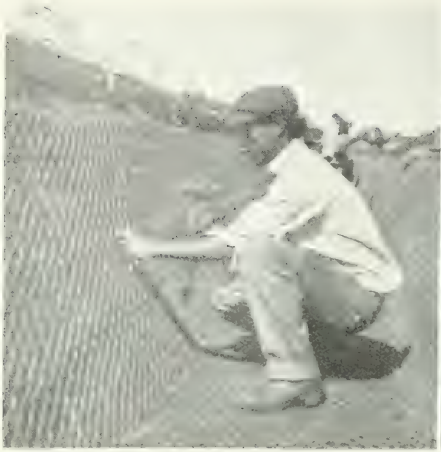

FIG. 1—LINING AN IRRIGATION DITCH IN HAWAII WITH CHICKEN WIRE REINFORCING

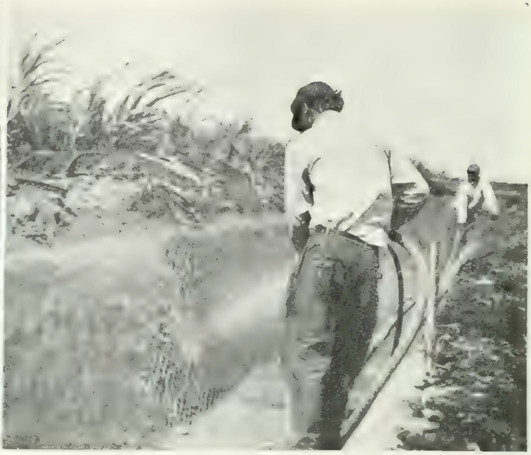

FIG. 2—APPLYING CEMENT MORTAR WITH THE "CEMENT GUN"

The large hose coiled behind the operator is carrying the dry mixed mortar under pressure. The dark line shows the hose, by which the water is applied at the nozzle

cog wheel. The wheel is run by a little air motor connected with the gun, and delivers material in these cogs or pockets to the blow pipe and into the material hose to the nozzle.[5]

The operation of the machine is as follows: First, the lower chamber is charged with a dry mixture of cement and sand. The valve between the two chambers is closed and the upper chamber is supplied with a like mixture. The valve at the top is then closed and compressed air is let into the upper chamber until air pressure in both is equalized. The pressure being equal, the weight of material in the upper chamber opens the valve and the mixture goes into the lower cylinder; the valve between is again closed and the air in the upper cylinder is exhausted. This lower valve is locked by the pressure from below and the upper one drops automatically by its own weight, and the gun is ready for another load of sand and cement. This method of the two cylinders insures constant pressure to the discharge pipe. As the feed wheel revolves it carries but a small portion of the mixture at a time into the air current. The speed of this feed wheel is regulated by the amount of air delivered to the air motor,—so the volume of stream can be changed at will.

The material is then delivered into a rubber hose (a pipe can be used part of the way) and to the nozzle. Water is added at the nozzle in the form of a fine spray. The water is forced through small holes leading from a water sleeve which surrounds the larger end of the nozzle. This water is delivered through a separate ½-in. hose and is under about the same pressure as air.

There is a marked difference between cement mortar applied by hand and the product of this machine. The latter is shot under a pressure of approximately 40 lbs. to the sq. in. and leaves the nozzle at a velocity of 200 ft. per sec., consequently it is far denser and of a much greater tensile strength than that applied by hand. One very important point in favor of machine-applied mortar is that the combination of cement and water takes place in transit and the mixture does not have to be moved after its initial set.

This is one of our worst troubles on concrete work in the islands. The laborers generally employed here do not realize the necessity of handling the mortar quickly after the water has been applied. I have seen them mixing so much at one time that it would be impossible to get it on inside of 30 min. to 40 min. This initial set, especially with some cement on the market, takes place quite rapidly, and the concrete is, of course, lost under these conditions. The men repeatedly do this thing unless watched, although explicit instructions to the contrary have been issued. This fault is entirely eliminated with the "Gun" method.

Comparative tests of mortar made by hand and by the "Cement Gun" show that the product of the "Gun" developed from 20% to 260% greater tensile strength and from 20% to 720% greater compressive strength than the product of the same mixture when applied by hand. These tests also showed that compared with the most carefully prepared hand made cement mixture, "Gunite" is far more impervious and waterproof.

We have at this time finished 2½ miles of open ditch and three short tunnels, their respective lengths being 250′, 400′ and 750′. The outfit has been entirely satisfactory and very good results have been obtained. On our larger ditch we have averaged about 100 ft. per day, a running foot being equivalent to 18 sq. ft. All the labor on the job has been under contract, varying on this larger ditch from 15 cts. to 20 cts. per lin. ft. This cost covers mudding where the section is uneven, wiring, man for nozzle, men mixing sand and cement and supplying the "Gun," a helper for the engine and all labor for moving the outfit.

The tunnel work has given us a good line on what is possible with the gun. In all three tunnels the engine and gun have been at least 100′ from the end of the tunnel. This in the long tunnel would make an 850-ft. delivery pipe or hose from the gun to the nozzle. Working at this distance, however, diminishes the output considerably, since the air motor cannot be run wide open as when the point of application is nearer. This means less material delivered to the discharge pipe and consequently less work.

We are constructing two new ditches, Haiku and Kauikoa, 10 miles and 4½ miles long. These are both practically all tunnels, ranging from 800′ to 3,000′. We expect to use the "Cement Gun" on all the surface possible. In some places where we have had cave-ins during construction or where the material looks dangerous we shall concrete both sides and roof. There will also be places where there is so much water coming in that a mortar will be insufficient and concrete will be used.

We expect to work both compressor and gun outside of tunnel for the first 500′, delivering material in pipe or hose to nozzle. Beyond this distance the compressor will be kept outside and the gun will be moved into the tunnel. This will shorten the material hose and thereby lessen friction, which means we

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[5] The article in *Cement Age*, Apr., 1911, referred to in Note 4, covers in detail the mechanical construction and the operation of the "Cement Gun"

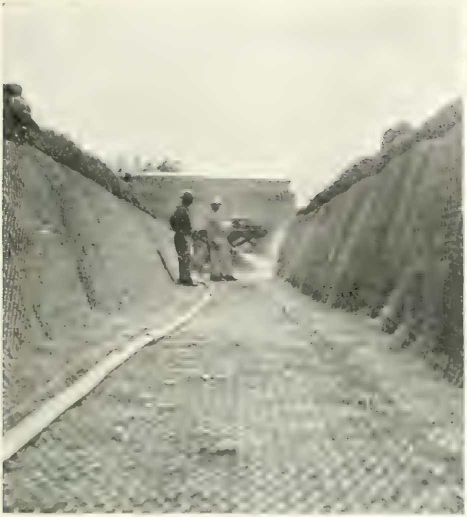

Fig. 3—A [illegible]
The Two Lines [illegible]

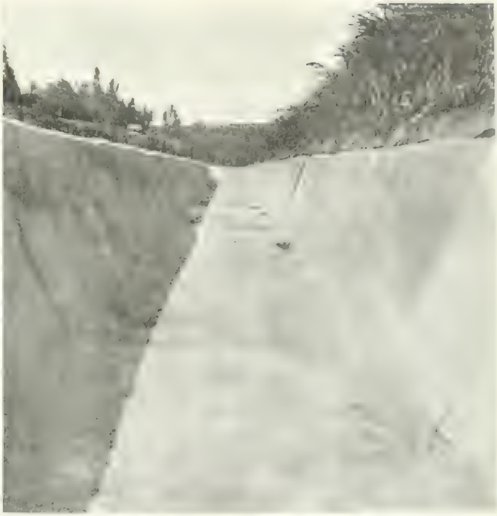

Fig. 4—A [illegible]

can run the air motor faster and accordingly can accomplish more work. The distance from compressor to gun—"the air-line"—makes little difference as long as all joints are tight.

The gas-engine-driven compressors furnished with the outfit would come in very handy for any riveting or light drill work. Everything is portable and little time is lost in moving from one position to another.

The following is the record of camplete cost of work for a period of five weeks on a ditch of 18-ft. cross-section[6]:

Labor, 260 [illegible] at $.1[illegible]	$ [illegible]
Cement, 370 bbls. at $3.50	1,295.00
Sand	10.00
Gasoline, [illegible] gals. at $.22	[illegible]
Wire, 5,200'—6 ft. at $.04	[illegible]
Wire, 2,600'—4 ft. at $.03	78.00
Superintendence	150.00
Incidentals	100.00
Cost of 2600 ft	$2,512.40

Fire in the building of the U. S. Geological Survey, Washington, D. C., May 18 last, did about $75,000 damage to topographic maps, geologic folios and reports. Fortunately the unpublished data and other material in the upper portion of the building, which are valued at nearly $5,000,000, were unharmed.

As a result of the fire, the Director has authorized a "fire sale" (warranted genuine) of slightly damaged folios at 5 cts. each. Regular price, 25 cts and 50 cts. Upon application to the Director, U. S. Geological Survey, Washington, D. C., a list of folios will be forwarded. There are about 188 numbers of the folios, covering fully the geology of 175,000 sq. mi. of the U. S.

It is indignantly denied that the *dry* condition of the material was in any way responsible for the fire.

Solving the Housing Problem in Paris

Awards have been made in the competition instituted by the authorities of Paris, having for its object the matter of securing low-cost housing under the most modern conditions of heating, ventilation and sanitation. Conditions in the French capital are such that our familiar spectre, the high cost of living, is no joke. Higher rents have forced workmen out of comfortable habitations and have reduced them to living under conditions that in many cases are little short of shameful.

Private and public philanthropy have both been invoked to provide better homes at a lower cost for work people, but nothing on a tremendous scale had been undertaken until the enterprise fostered by the city of Paris. The recent competition is but the beginning, for it is ambitiously purposed to provide dwelling places for 300,000 to 400,000 people, with an ultimate expenditure of $100,000,000.

The first available site for the proposed community dwelling is one bounded by the Avenue Emile-Zola, the Rue Nouvelle and the Rue de Javel, having an area of 2,425 sq. m. (2,028 sq. yds.). With this as a site, contestants were asked to design a building, or buildings, which should not "give the idea of a barracks, a community of workmen or an asylum." Five types of apartment were to arranged for: First, a room combining a dining room and a kitchen, or a dining room and a separate kitchen, a room for the parents, three for children, toilet conveniences and an entrance, with a minimum area of 3,025 sq. m. (2,529 sq. yds.), at a maximum rent of 550 fr. ($110) per yr.; Second, the same, except that there were to be two rooms only for children, and to have a minimum area of 2,025 sq. m. (1,776 sq. yds.), and a maximum rent of 500 fr. ($100); Third, same, but with a single room for children, minimum area 1,225 sq. m. (1,024 sq. yds.), maximum rent 400 fr. ($80); Fourth, without a children's room, minimum area of 625 sq. m. (522 sq. yds.), rent 300 fr. ($60); Fifth, to consist simply of one sleeping room and a tiny kitchen, containing 324 sq. m. (270 sq. yds.), rent 200 fr. ($40). These five types were to occupy the following percentages of the whole structure: No. 1, 10%; No. 2, 35%; No. 3, 40%; No. 4, 10%; No. 5, 5%.

Contestants were invited to provide for the details of heating, lighting, power where needed, store-rooms, laundries, dry-rooms, shower-baths and so on, but were required so to arrange these conveniences that their installation and up-keep would not require more than the maximum rent allowed, in order to pay 4% net on the investment. Any space available on the ground floor might be planned for additional rooms to rent and for shops. Certain things were forbidden in the plans—courts completely enclosed; courts opening off kitchens, the latter requiring to be lighted from courts having at least the area of living rooms; lighting living rooms from covered courts; alcoves in bed rooms; bath rooms lighted or ventilated by air-shafts. Stair cases had to be built fireproof, cellars to be well ventilated and service corridors perfectly clear.

No plan could be considered which did not include a detailed estimate of erection and maintenance which would include all fixed charges and show a satisfactory net revenue. In spite of the provisions named and the real difficulty of the problem presented, 58 plans were submitted. The first prize was won by M. Payret-Dortail, a well known French architect.

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[6] This "18-ft. cross-section" to quote Mr. Collins, refers probably to the 18 sq. ft. per lin. ft. mentioned above. This means a cost of $0.966 per lin. ft. of ditch, and $0.054 per sq. ft. of surface covered.—Editors

The Payret-Dortail plans call for two wholly detached buildings, seven stories high, with connecting buildings, six stories high. Three large courts are provided, with landscape garden effects. The courts contain 951 sq. m. (795 sq. yds.) and the ground plan of the buildings contains 1,473 sq. m. (1,231 sq. yds.). Rooms opening onto two of the courts are provided for two janitors, one of whom is to give attention to bath rooms and toilets; there will be two men on duty at night also and other features of the building are a mortuary chamber, an office for the payment of rents and a shop.

Opening onto the central square are three nurseries, one for babies and two for boys and girls; a public laundry, divided off into 36 spaces, with complete fittings; and bath-rooms. The latter include two bath-tubs and five shower-baths for men, and for women four bath-rooms, with bath-tubs for children also, and two shower-baths. All bath equipment is provided with hot water. The ground floor also includes four apartments of Type No. 4, one of Type No. 3 and four shops. In the basement are free and pay storerooms for the care of bicycles and baby-carriages, the heating apparatus and cellars.

In the apartments, some of the dining rooms are separated from the kitchen and in others these two rooms are thrown together, but in every case inconvenient corridors are ingeniously avoided. Where the dining room and the kitchen are together the latter may be shut off by curtains. Large balconies are furnished in some of the suites. The common rooms are about 4.5 m. x 3 m. (14.85′ x 9.9′). The bed rooms, many of which are arranged so that they can be divided off to accommodate children, are about 3.6 m. x 2.65 m. (11.88′ x 8.745′). This gives the apartments as a whole an area slightly greater than that called for in the conditions governing the contest.

The disposal of garbage is arranged for by receptacles placed outside the apartments, on the landings of the stairways.

In the building as a whole there are 143 apartments of the types enumerated, comprising a total area of 6,657 sq. m. (5,566 sq. yds.), which include 472 rooms and accommodate 702 people. The average rent of the apartments is 143 fr. ($28.60) for each room.

Paully Tiles at Panama.

The Canal Commission is installing a complete plant to manufacture Paully concrete tiles for building purposes in the Canal Zone. A. A. Paully is on the ground in charge of operations.

How Drinking Fountains Are Made and What They Cost.

The concrete drinking fountains in use in Chicago parks were mentioned and illustrated with a photograph in an article, "Attractive Use of Concrete in Chicago Parks," by Marc N. Goodnow in the Nov., 1912, issue. From the South Park Commissioners, Chicago, we now have detail drawings and data on these fountains as follows:

The concrete drinking fountains used in the South Parks are manufactured in the South Park concrete shops.

Wooden forms or molds, having interior dimensions the same as those given on the blueprints for the fountains, are set up and filled with a concrete mixture composed of about 5 cu. ft. of torpedo sand, or crushed granite, and 2 bags of some good brand of Portland cement. This mixture is made wet enough so that it can be poured.

About 20′ of ¼-in. iron rod are used for reinforcing the concrete. One ring about 2′ in diameter is placed in the top rim, a smaller one in the bottom of the basin, and a large ring in the base. The iron piping for the plumbing sufficiently reinforces the pedestal.

The plumbing work used in these fountains is also manufactured in the South Park shops, and is cast in the fountain, being placed in the mold before the concrete mixture is poured in.

The molds are allowed to stand until the fountains are well set, which takes about 48 hours in good drying weather. After molds are removed the outsides of the fountains are washed with acid, which dissolves away the cement and exposes to view the aggregate, giving the fountain a more pleasing appearance.

Different kinds of sand and crushed stone and granite have been used in manufacturing these fountains.

As to cost:

Concrete material and reinforcing iron	$ 1.40
Plumbing work — material and labor	8.00
Labor of concrete workers at present wages	6.40
Overhead charges and shop expense, about	1.50
Cost per fountain	$17.30

"Curing" Hollow Walls by Filling Them With Water

BY A. S. MERRIETT*

The necessity for keeping newly-cast concrete wet to a certain degree and for a certain length of time in order for it to set properly is generally understood. Concrete that dries out too rapidly contains cement that has in reality had no chance to be of service. These vital points are perhaps better understood in extremely dry climates like those in the West than in the eastern states, where the air is more humid and there is always more or less rain at all seasons.

In California it is necessary in laying concrete sidewalks to keep them covered with damp earth for several days, and buildings of concrete must have the board forms left on the walls for as long a time in addition to constant wetting, all in order to prevent too rapid drying out.

When walls are cast with forms like those of the Merriett[1] system, they can be made hollow by means of their cores, which set in the forms when walls are cast and afterwards collapsed and removed. Thus the walls can be "seasoned" as above mentioned by simply filling the hollows with water. It is not necessary to provide for drawing off the water, although this can be done by a hole into the core at the bottom, as it is all absorbed in this process of "curing." It is surprising to see the amount of water a piece of concrete work will absorb when green. The more water it gets the stronger and harder it becomes. This fact should be appreciated as fully in all localities as in the very dry ones, as concrete everywhere would be much better if this principle were applied.

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*Merriett Concrete Forms Co., Los Angeles, Cal.

[1] Described in the Apr., 1913, issue, p. 202

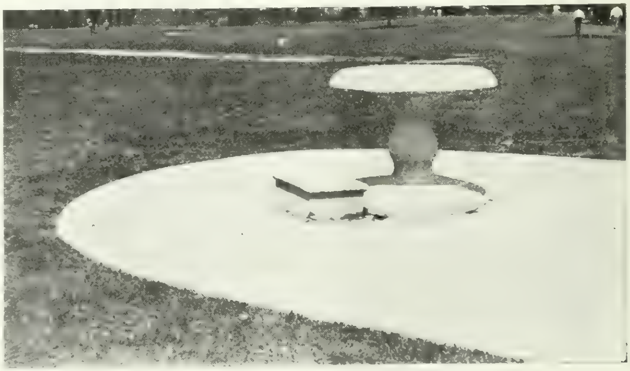


FIG. 1—CONCRETE DRINKING FOUNTAIN

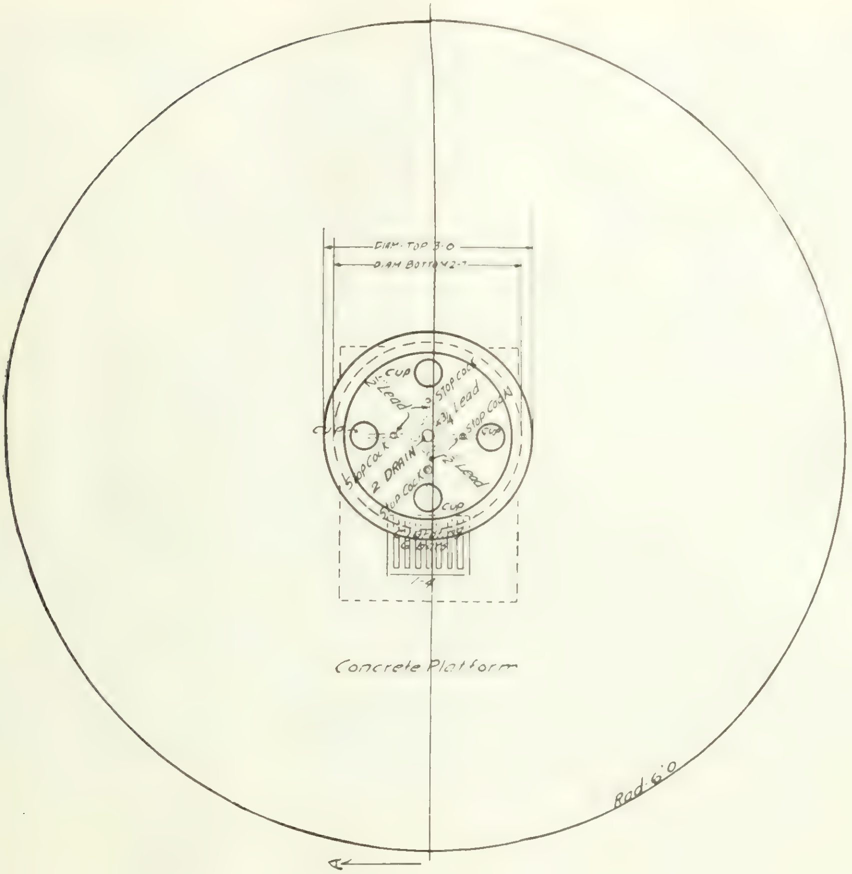
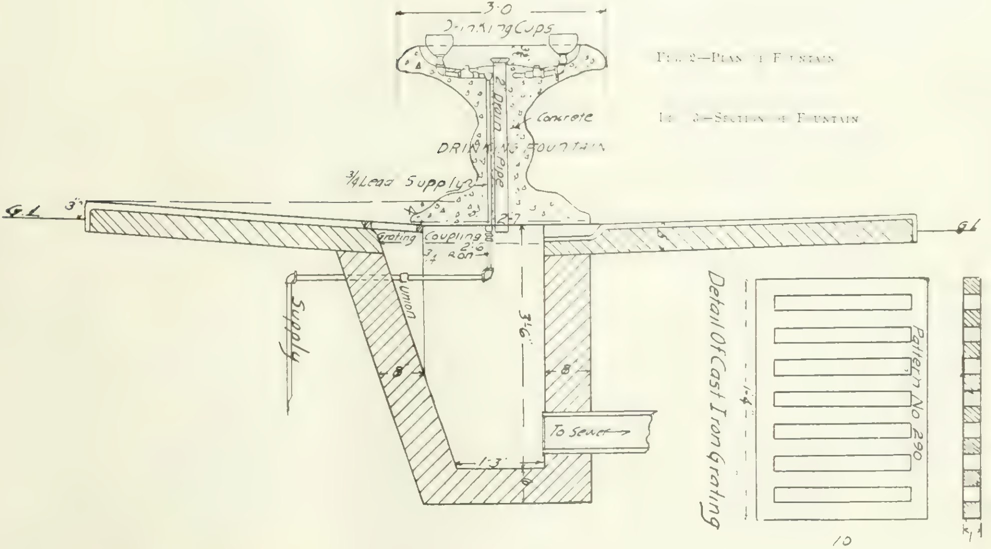


Fig. 2—Plan of Fountain

Fig. 3—Section of Fountain



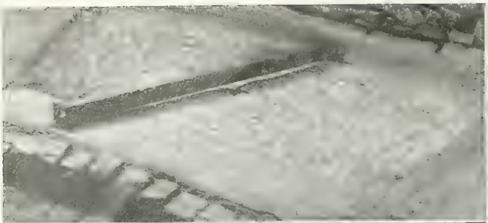


Fig. 1—(Top row at the left) Shows Pavement Sections Nos. 5 and 10 Before the Start of the Detroit Portion of the Test. 19,000 Revolutions had Already Been Made on No. 5 at Chicago, and None on No. 10

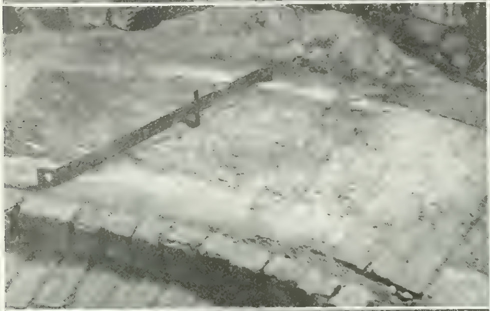


Fig. 2—(Center left) Shows Section No. 5 After the Finish of the Detroit Test or After Approximately 39,000 Revolutions of the Determinator

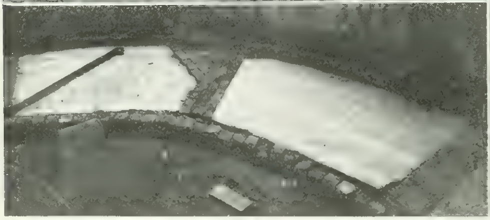


Fig 3—(Bottom left) This Shows Section No. 10 After the Finish of the Detroit Test, the Slab Having Suffered the Wear from 20,400 Revolutions

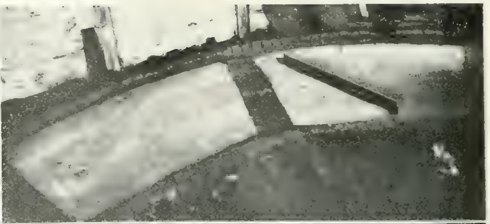


Fig. 4—(Top right) This Shows Nos. 11 and 7 Before the Start of the Detroit Test. No. 11, at the Left, Has Had No Previous Wear. No. 7 Already Had Undergone 19,000 Revolutions of the Determinator at Chicago

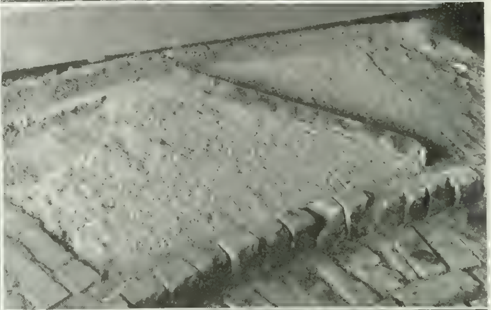


Fig. 5—(Center right) This Shows Section No. 11 After the Finish of the Detroit Test

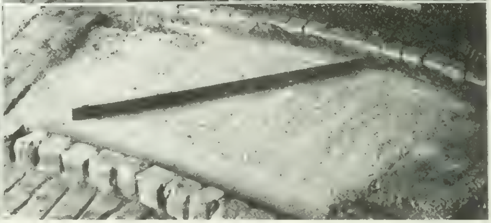


Fig. 6—(Bottom right) This Shows Section No. 7 After Approximately 39,000 Revolutions

A Severe Test of Paving Slabs

Efforts are Made to Determine the Best Concrete Mixtures to Resist Traffic Wear

Tests to determine the relative wearing qualities of various mixtures of concrete in pavements have just been completed under the direction of the Inspection Bureau of the Universal Portland Cement Co., Chicago, using the "paving determinator," owned by the Detroit Department of Public Works, the operation of which was described in an article in the Dec., 1912, issue, which also reports the result of tests made on several different types of pavement. This machine was devised by John C. McCabe to reproduce in a highly accelerated degree, the actual wear and tear on the pavement, occasioned by heavy horse-drawn vehicle traffic.

The machine consists of a central vertical column or pivot about which revolves a horizontal shaft having heavy solid metal wheels on either end. The wheels are 48" in diameter, have 3-in. tires and weigh 1,400 lbs. each. While the wheels remain at a constant distance apart with respect to each other, as they move around the central pivot, the radius of one increases and that of the other decreases, so the surface traveled is subjected not only to rolling friction but also to heavy abrasion caused by the constant shifting in and out of the wheels.

To reproduce the wear due to rough-shod horses, each wheel is provided with five plungers on the ends of which are metal plates shaped like the bottom of a horse's hoof, each plate having four steel points similar to horseshoe calks. As the wheels revolve, these plates strike the surface traveled a heavy blow, regulated by means of a cam gear and springs.

The greatest wheel radius of the machine is 10' 10". The least radius of travel of the inside edge of the wheel is 8' 7" and it requires approximately 330 complete revolutions for a wheel to shift from the inside to the outside of the circular ring 27" wide that it travels.

Tests made in Detroit and just completed the week of May 26, are in reality a continuation of tests begun at the Chicago Cement Show last January. A description of the concrete test sections

(Continued on Page 305)

Cement a Factor in the Country's Development

Of the manufacturing industries based on mineral raw materials, one of the most important is the production of Portland cement. This is due not so much to the direct commercial value of the finished product, though the output of Portland cement in the United States is now worth $60,000,000 to $70,000,000 a year, as to the way in which the product enters into general industry. Practically all our great engineering works are composed, in part at least, of cement; many of the larger buildings everywhere are built of reinforced concrete; while in smaller individual lots, but in a vast aggregate, cement finds use on farms, in mining work, in building railroads and irrigation works, as a paving material, and in countless applications elsewhere.

The entire growth of the Portland cement industry in this country has been a matter of a few decades, for the American output in 1880 was only 42,000 bbls., compared with a present annual output of 82,000,000 bbls. Its growth was at first hindered by mechanical difficulties in plants and machinery, most of which were overcome by American genius, so that now we find plants in Japan, Australia, England, Germany, and South Africa using types of kilns and other machinery that were originally invented or perfected in the U. S.

The U. S. exports very little cement, the quantity annually shipped ranging from 1% to 3% of the domestic production. It is probable that in the future much more serious attention will be given to the export trade, particularly by the eastern mills, for its development seems to be the simplest method of disposing of the surplus which now periodically weighs on the eastern cement market. Of course an export trade in a commodity like cement—relatively bulky and low in value—does not promise any large direct profit to the individual producer, but indirectly the creation and maintenance of such a trade will benfit the industry as a whole. Owing to the scarcity in most parts of South and Central America and the West Indies of the fuel supplies necessary to the manufacture of cement the development of local cement industries in these promising markets seems unlikely.

Poured Houses in France

In a recent issue of the *Daily Trade and Consular Reports,* it is announced that the Campagnie des Produits Chimiques d'Alais et de la Camargue will build this spring at Salindres (Gard) where the head office of the company is located, 120 workingmen's houses of poured concrete. Plans for a typical structure were shown on p. 212 of the May, 1913, issue, and the system used will be the one developed by Geo. E. Small and H. J. Harms, Jr., which was described in detail in the same issue.

Concrete Roads—Michigan and Elsewhere

[CONCRETE-CEMENT AGE has devoted a great deal of attention to the methods employed in the construction of concrete roads in Wayne county, Mich. This is undoubtedly justified by the fact that these methods have made such a success of highway work that Wayne county has become a mecca for road builders active and road builders prospective. In the Jan., 1913, issue we published a paper on these methods written by Edward N. Hines, a member of the Wayne County Road Commission, which he had read at the December convention of the National Association of Cement Users.

Below is published an abstract of a still later address by Mr. Hines—one which he gave at a meeting of the Western Society of Engineers. While some of the matter retained for publication here by courtesy of that Society has been previously covered, the peculiar value of the address which was read at Chicago, is in the discussion which followed it. Mr. Hines's talk was informal and details were taken up in the discussion which throw some new lights on the work. Those who are not familiar with the work in Wayne county should follow all the details, but even those who are familiar with the work will find much benefit in following the discussion. In this Mr. Hines and others were well able to bring out many things of unusual interest.—EDITORS.]

Our first experience was along the line of bituminous macadam construction. That seemed to be, at that time, the "last word" in road construction down East. We followed specifications closely, but with the enormous traffic which our main, leading highways out of the city of Detroit were called upon to carry, we found in Wayne county, as is being found all over the country, that the automobile rapidly scatters the roads in fine particles over the fences and into the ditches. Instead of continuing to build a type of road which we felt was not a success, in our locality at least, we looked around to see what we could do to save ourselves from a constantly increasing maintenance charge and a constantly deteriorating road; from observation based upon the experiences of nearby country towns with bridge floors and with cross-walks built of light concrete construction, we decided that concrete would solve the problem for us.

I might state in this connection that before we adopted concrete we built rock asphalt, we built brick, we built tar macadam, we built asphalt macadam, and we built plain water bonded macadam. Our experience was unsatisfactory in all those materials with the exception of brick, and the cost of brick in our locality, for our purposes, is prohibitive.

We devised the concrete road, of which we now have about 65 miles. In 1913 we expect to add some 40-odd miles, and from our experience we are not going to build anything else but concrete. We believe, with the past five years as a guide, that a concrete road is a practical and economical form of construction which merits and is going to receive a great deal more attention in the future than it has received in the past.

Wayne county is in a valley, is flat, and not easily drained. It consists largely of a clay sub-soil. Here and there we strike stretches of sand, but clay predominates. It is a common occurrence on the unimproved roads of Wayne county to be obliged to pry oneself out of the mud.

At an ordinary rate of speed the automobile has no effect on a macadam road; in fact, I doubt if it has as much effect as a horse-drawn vehicle. But as the speed of the automobile increases, it begins to tear up the road, causing clouds of dust, that is, road material, to scatter over the countryside. The theory of the macadam road is, as you know, that the abrasion of the horses' hoofs and the abrasion of the steel tires makes enough small particles to act as a cementing material to hold the road, but the automobile comes along and scatters the fine particles over the countryside; the faster it goes, the more dust, and the people who use the roads are not going to put up with the clouds of dust, let alone paying to replace the material that is being blown off by the automobiles and other vehicles. Riding behind a cloud of dust of that character is not only unsanitary, but it is a dangerous proposition. If you could see the horse-drawn vehicles moving along the concrete roads with the tugs tightening and loosening as they go along, you would be satisfied as to the easy traction of these roads. They are not only dustless in summer but mudless at all times. They afford good traction for all types of vehicles. The drier the weather, the less dust there is on the roads. What dust you find on the concrete road is dragged on from the side roads in muddy weather.

A feature in favor of the concrete road is the small crown necessary to get rid of surface water—¼" to the foot. A horse cannot come along and pick out a track. He must be driven, irrespective of what part of the road he is on, and the driver is comfortably seated. On the ordinary type of macadam road the driver keeps up on the crown of the road so that he can ride comfortably on the seat.

As an index to the efficiency of our organization in building our roads we handle 1,000 cars per month, spent $600,000 in the road building season of 1912, take care of a voluminous correspondence, and look after the detail of this work, with four people in our office, at an expense to the county of $6,223 last year.

This will give you some idea of the systematic methods that are employed. We believe that it is desirable to use machinery wherever we can get the same or better results. Man labor and horse labor are scarce and expensive during the summer season in the country districts.

The hauling of materials is done largely with hauling wagons drawn by traction engines. In our busy season last summer we employed about 1,200 men. We find, as we get away from the centers of population, that it is difficult to take care of our men and it becomes necessary to house and feed them in camps along the roadside.

A steady supply of material is not always available, so that we stock up such material as we can obtain. Wayne county is particularly poor in good road material and everything is shipped in. We are using washed and screened gravel, and washed and screened sand. The gravel ranges in size from ¼″ to 1½″, and the sand from ⅛″ down to dust. We made concrete in the proportion of 1 part cement to 3 parts of stone and sufficient sand to fill the voids. Wherever we can, we stock the material at convenient points along the roadside and rehandle it during the coming season. We find that we can rehandle it with a clam-shell and with a Brown hoist[1] cheaper than we can stand for delays during the working season. Our season is short, and we have to do a large amount of work in a short space of time. With a gang of 34 men—including the foreman, the man who runs the mixer, the man who sprinkles the sub-grade and the finished concrete to cure it, the two men who cover up the concrete to prevent its drying out, the fireman, the floaters, and all laborers—we build in a day, under ordinary circumstances, 550′ of concrete roadway 16′ wide and 7″ thick at the sides, with a crown ¼″ to the foot. This we consider a good day's work.

We have to use a combination of hauling engines and hauling equipment with the horse-drawn vehicles. The hauling equipment is not practical over unimproved roads in wet weather, but in dry weather it is a practical and profitable proposition. We haul two or three wagons in a train as a general rule, depending upon the condition of the road over which we are hauling. In some cases the sub-grade is so bad that all we can haul with an engine is one wagon. That wagon contains seven tons and it will make as many trips in a day as a good team. Under exceptionally favorable conditions we have unloaded, with six men and an unloading device, as many as 25 cars in a day—not often, however.

The better care and the better attention given to the sub-grade, the better the final result will be. We prepare our sub-grade flat, rolling it hard, and level. In order that it may not draw any moisture from the concrete, we sprinkle it thoroughly before placing the concrete. Of course, on the sandy sub-soil there are less difficulties from cracking than on clay. We lay concrete right on the clay sub-soil, just the same as on the sandy sub-soil. With the material stocked along the side of the road, and with the type of mixer that we are using, we can work and unload our material close to the mixer.

The mixer is a very economical device. It has a boom 20′ long which projects from the front end, and swings in the arc of a semi-circle. The bucket conveying the concrete from the mixer moves out under its own power on the boom.

Our mixture is a rich one—1:1½:3. We have tried 1:3:5, 1:2:4, and 1:2:3, but experience has taught us that with the 1:1½:3 mixture we obtain the best results. We believe in thoroughly mixing our concrete, and use a wet mixture. We grade our materials so as to make the finished product as dense as possible.

We put down 2-in. x 7-in. side rails, and the template is drawn back and forth to give the road its initial shape. The final finishing is done with wooden floats. The men work from a bridge. After the concrete is once in place, no one is permitted to step in it or throw anything on it, as that forms depressions or ridges. That would be cause for instant dismissal of the offender.

We sprinkle the concrete for eight days and cover it with loam, sand, or any convenient material, to a depth of 2″ or 3″ to keep it from drying out.

Last summer an adjacent county built an asphalt macadam road at a considerably higher price per sq. yd. than our road cost. Aug. 17 this road was opened for traffic. Nov. 1, I went over the road and counted 137 holes in the first mile, counting nothing as a hole that was less than a foot square. This will give you an idea of the amount of traffic. I do not mean to intimate that it was a poorly constructed road; simply that it will not stand the traffic that it is called upon to carry.

Our roads are not only good automobile and horse-driven vehicle roads, but are good for bicycles, roller skates, marble playing, and many other purposes.

On the maintenance feature especially the concrete road excels others. With over 60 miles of road, some of it in its fourth year, some in its third year, and some in its second year, we have not spent $300 for surface maintenance—not on a mile but on all of it, and not in one year but from the time we laid the first mile until the present time.

Every test to which the concrete roads have been subjected only emphasizes their good points.

In the city of Detroit last year there was a great deal of discussion occasioned by the deterioration of the pavements. An investigation committee was appointed, with the Board of Commerce taking the initiative. The Common Council voted an appropriation and placed it in charge of John C. McCabe, who designed an ingenious machine whereby the conditions of actual wear by traffic may be approximated as closely as possible.

The "paving determinator"[2] used in this test reproduces, though greatly accelerated, the wear and tear on pavements occasioned by heavy horse-drawn vehicle traffic.

The first test made was on various types of pavements consisting of cedar block, creosoted block, granite, four kinds of brick, and concrete. An 8-in. concrete foundation was prepared, and the cedar block, the granite, the creosoted block and the four different kinds of brick were laid on this foundation with a 2-in. sand cushion. There was also a section of concrete 6″ deep built according to the Wayne county specifications. The first thing that went to pieces was the granite block, strange to say. The grouting gave way and a wear of over 1 in. took place. One section of the brick wore so badly that it had to be removed entirely, because the mechanism of the machine could not get over that section. Other sections of the brick wore from 1″ to 3″, and not only to that extent but irregularly and in patches. The wear on the concrete was almost imperceptible, and it stood up the best of any of the materials that were tested. The next best material was the creosoted block, which in our locality costs about three times as much as the concrete.

The Wayne County Road Commissioners, in the work that they have done, have demonstrated (at least to their own satisfaction) that concrete is a practical form of road construction. They do not come to you with anything to sell; they do not control any processes or any patents. It is purely a question of fact and not of opinion. These concrete roads are there and they are either good or not good. We do not say that concrete is a panacea for all road ills, but we believe that it is a practical and economical form of construction, worthy of receiving consideration, not only for country roads, but for residence streets in cities and villages.

Discussion[3]

At the outset, Langdon Pearse, mem. W. S. E., asked Mr. Hines for further information as to cost and as to the effect of concrete paving on horses' hoofs, this question having arisen in the design of some municipal stables, the stablemen saying that concrete injured the hoofs.

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[1] Brown Hoisting Mchy. Co., Cleveland

[2] Described and illustrated in Dec., 1912, issue

[3] In giving the information developed by the discussion we have made no attempt to preserve the original form of the discussion but have abstracted it, omitting the question when the answer by itself is sufficient to convey the meat of the matter.—Editors.

Mr. Hines: The question of cost, as I see it, is largely a local one. I think that in the building of the roads too much consideration has been paid to the man who attempted to build the greatest amount of yardage for the least amount of money, forgetting that cost is an annual affair rather than a first affair. We have built concrete roads in Wayne county as low as $1.04 per sq. yd., figuring in the drainage, the engineering, the culverts, sub-grading, and grading—all those things—figuring on the concrete yardage only; and we have built them at a cost of as high as $1.71. The conditions on a given mile of road are not necessarily the same as on some other mile. We pay $1.00 per ton for washed and screened gravel. The lowest price that we have paid for washed and screened sand is 83 cts. per ton. We have paid as high as $1.85 per ton for gravel, and $1.55 per ton for sand. We cannot approximate costs under such conditions. We have hauled as short distances as half a mile and as long distances as nine miles. The question of cost is something that must be settled in individual communities. I think our cost has been on an average about $1.50 per sq. yd. I do not think we shall ever be able to build at as low a cost as $1.04 again, and I think under ordinary conditions we shall not have to pay as high as $1.75 per sq. yd. We have an efficient organization and are putting all the money necessary (not with the idea of being wasteful) into making a good road, a durable road, and a road easily and cheaply maintained.

I think the question of maintenance on concrete roads is worthy of more attention. When we reflect that less than $300 has been spent for surface maintenance on nearly 65 miles of road, it is a striking contrast to what is being spent for maintenance in other sections of the country. I do not want you to infer that we are allowing our roads to deteriorate, for we are not. They are being maintained in a first-class condition.

In New York state last year, they show through their reports (if I am able to figure out what their reports mean) that they spent on an average of $1,010 per mile per year for maintenance. The Massachusetts state report shows that on 243 miles of bituminous macadam road in 1911 they spent an average of $1,293 per mile for maintenance.

It will not take many years, with the freedom from maintenance which our roads have had up to date, to overcome a big handicap, and, in fact, to be able to tear them up and replace them.

On Grand River road we built two miles of tar macadam roadway. It was built as well as the engineering skill and the art of the road builder could do it, but we had hardly finished the work before we had to go back and repair it. In the last six years it has been re-surfaced five times.

Knowing what I do today, if anybody should come to me and say, "We will build you two miles of tar macadam road and not charge you a penny," stipulating only that the road should be properly maintained, it would be more economical for us to reject the offer and build a concrete road at a cost of $12,000 to $13,000 per mile. In eight years we would be money ahead.

With reference to the question of horses' hoofs, many people from all sections of the country come to Wayne county to see what we are doing, and that question is one of the first asked. I simply say to the gentlemen who are going out to look over the work, "Don't ask me; I don't know anything about it; ask these teamsters." The average teamster or farmer will say concrete pavement is not hard on the horses' hoofs. Occasionally one will say it is hard on the horses' shoes, but it is easy on his shoulders, because he can pull the load with half the effort. I think that it may be hard on the horses' shoes, but no harder than the granite block. When they talk about the resiliency of granite block as compared with concrete, I cannot quite see it.

Question. Did you provide any of the drainage area with clay road?

Answer. We are handicapped on the drainage proposition, from the fact that the drainage areas do not restrict themselves to township or county boundaries. We believe we could get better drainage if we could reorganize these conditions, not only in Wayne county, but in adjoining counties; but we cannot do this and so we manage the best we can under the circumstances. Here and there we are able to carry drainage to its logical outlet and then we go down deeper than where we are handicapped by the fact that in the next township conditions are different.

Q. That is not answering the question. Should you not have additional drainage with a heavy clay soil? The soil is mostly sand, isn't it?

A. It is mostly clay.

Q. Is it as heavy as Wisconsin clay?

A. I don't know about Wisconsin clay, but clay, of course, is not an easily-drained sub-soil, and wherever we can we give it all the drainage possible.

Q. Do you not give it additional drainage, except the side ditches?

A. No. Where we have street-car tracks along the side of the road we are laying 4-in. land-tile.

Q. The $300 per year for 65 miles is just for surface maintenance, then?

A. Yes, and it does not include cleaning out ditches or cutting weeds.

Q. I am interested in the repair of the pavements in case there are worn places in the concrete surface.

A. We have not yet had any worn places, but we expect we shall have, eventually. When that time arrives the concrete can be used as a foundation either for a very thin bituminous coating or for some thicker coating of asphalt, brick, or any other surfacing material that may be evolved in the future.

Q. Do you find any need for expansion joints in the work?

A. Yes, we do. We are making a ¼-in. joint, with asphalted felt cutting clear through the concrete and protected on the edges by Baker[4] armor plates. We make these every 25′, but that is purely an arbitrary distance. It is possible that the joints could be carried farther apart, but our results have been so satisfactory and the saving of taking out a few of those joints is so slight that we have not deemed it desirable or advisable to go ahead and experiment. Of course, we are not running an experiment station, and if the government evolves a distance of 30′ or 40′ that proves as good as ours in practice, we shall adopt it.

Q. In this last year we constructed about a mile of concrete road 16′ wide, in which, on account of a limited amount of money, we did not provide steel-bound joints, and we all regret it. We would not construct any pavement of this kind now without steel-bound joints.

A. In the first year or two of our experience, we experimented with several forms of joints, namely a Georgia pine board; tar paper; an angle iron. We tried dividing it and putting in a composition of pitch and asphalt, and various other plans that we thought would prove practical We found there was a tendency on the part of the concrete to spall at the joints. We have stopped that spalling by filling the joints with heated tar and coarse sand, spreading it 2″ or 3″ each side of the joint; it prevents further wear, protects the road, and makes a nice, even, level surface. We feel, with the experience we have had, that the only place that we are looking for improvement now is in the matter of leveling up our road so that there will be no ridges or depressions. We want a road that you can squint along for two miles and knock a fly off with a rifle bullet.

Q. Do you not find that with the steel plates you have a rough joint? That is, does not the road, the surface proper, wear down faster than the steel joint?

A. Neither one of them has worn as yet.

Q. Will not that be the case later?

A. I think not. This is a soft steel plate, and I think if there is any particular wear there in the future, the steel will wear with the rest of the road. We have had that kind of plate in use three years now and the wear seems to have been the same on the steel as on the road.

Q. In case there is a very soft place in the clay, and you cannot roll it, do you put the concrete on regardless of that?

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[4] R. D. Baker Co., Detroit.

A. Yes, we have done that.

Q. Do you make the concrete any thicker or do you reinforce it?

A. We have not done any reinforcing except on a few experimental sections. Here and there the concrete has been made thicker, but I do not advocate that, because I believe cracks will develop where this practice is followed. Where we have had soft spots of any size, we have dug them out and filled them with stone. In the case of small ones we build over them.

Q. Do you work only when conditions are proper to make the sub-grade?

A. Yes. We have a large amount of work to do and we get started as early in the season as we can; while it is more expensive to prepare the sub-grade in wet weather, yet it can be prepared in a suitable manner by building the side ditches and making some provision to take the surface water off before the concrete is laid.

Q. Do you do any work in freezing weather?

A. We have done some, but our hearts stood still all the time we were doing it.

Q. The part of the country I come from—Minneapolis, Minn., and North Dakota—the frost penetrates the ground some 8′ to 10′ in the winter. With proper drainage on the side, do you have any trouble with the concrete or earth caving in so as to affect the concrete?

A. Last winter (1911-1912) was a severe one in Wayne county; the frost went down 5′ or 6′ and it did not affect our roads at all.

If I should say that everything we had done was A1, it would insult your intelligence, because it is not A1. We have made some mistakes, lots of them, but we have not made the same mistake twice. When we started out, we contracted our jobs and went into competition with the contractor where conditions were similar; we are now doing all our work under the day-labor plan, believing it to be more satisfactory. Our first work does not begin to typify the work we are doing today. The work we are doing today is very much better. Here and there a section has been heaved by the frost or other causes, but I think over the 63, 64, or 65 miles there are not more than a half dozen sections which have heaved up perhaps an inch. I presume it is possible to eliminate all such conditions. It is necessary to take the practical cost of the proposition as well as the theoretical.

Q. Has the heaving been more pronounced on the clay than on the sand road?

A. It has been largely on the clay.

Q. In Minnesota and Wisconsin most of the roads are sand.

A. They ought to make ideal roads for building concrete.

Q. A few moments ago you mentioned the development of certain cracks. To what cause do you attribute those cracks, have they appeared on the later roads, and is it important to eliminate them?

A. The first mile we built was on Woodward Ave., and we built that with what, for want of a better name, I would call an inverted curb. We had a curb going down some 4″ or 5″. We had an idea that this was going to be quite a "nifty" thing. I do not remember now what the idea was, but the tendency due to expansion and contraction from heat and cold and from moisture was to present a resistance there that it could not overcome, and it just pulled it apart in the middle. More cracks have developed on that one mile than on any other subsequent 15 miles outside of the first two miles on Michigan Ave. On the first two miles on the Michigan Ave. road, the cracks are due entirely to a very, very poor foundation. Michigan Ave., when we took it over as a county road, did not exceed 15′ in width, measuring from the street-car tracks, and we widened it to at least 24′. We made that fill and built on it in some cases two weeks after it was made. It is not surprising that we developed a great many cracks. On the work we did last summer, of course, I do not know how many cracks will develop, but the work done summer before last did not develop more than three or four cracks to the mile, which is a negligible quantity.

Q. What has been the attitude of the taxpayers, that is, the property owners?

A. The taxpayer says: "When are you coming our way? Our road has the most traffic of any road in Wayne county. You ought to come out here, because it is the most important road in the county." After we started to build concrete roads, the people of Wayne county said that we were not going fast enough, we were not building enough miles, and they wanted to bond the county for $2,000,000 to be spent in one year. We had to fight that proposition. The people said: "What kind of a bunch is this? They fight for these roads. Then we want to give them $2,000,000 and they turn around and will not take it." I recall an editorial in one of the papers. I had said we had not developed the organization to spend any such sum of money and the newspaper said, in substance: "We went over this road yesterday and it looked just as good as the day it was put down. This man doesn't know what he is talking about."

We finally compromised on the basis of extending this expenditure over a period of five years. There is great demand from every corner of the county to "come out our way."

Q. Have you constructed any curb in conjunction with your paving proper?

A. We have not. On Jefferson Ave. the village of Grosse Pointe Farms has since constructed a curb.

Q. You mentioned 18′. What has been decided on as an ideal width for concrete roadways in Wayne county, including shoulders?

A. We have made a definite plan covering a period of years and have largely, in our own minds at least, decided in which direction we are going and have divided our roads into three classes: First, the trunk roads, which are the main roads leading into the city of Detroit. On these we have determined a width of concrete of 16′ with a minimum width over all, including the shoulders, of 24′. The shoulders we are building of limestone or gravel, depending upon the respective availability of the materials. Second, the lesser traveled roads. We term these our secondary roads; they connect the smaller centers of population one with another. We have laid them out largely with a width of 15′ of concrete, 24′ over all. Third, the subsidiary roads. We are putting these down with 12′ of metal and 24′ over all, with gravel and limestone shoulders, making the metal or the concrete 12′ and 3′ additional on each side of limestone or gravel, and the balance earth.

Q. Do you consider the 16-ft. road wide enough for automobiles going in opposite directions at a fairly good speed, 25 miles or 30 miles an hour?

A. That has been our experience, and with good limestone and gravel shoulders there is plenty of turn-out room. With 24′ over all and 16-ft. metal, it is a good, safe, two-track road.

Q. Have you ever noticed two loads of hay passing one another on a 16-ft. roadway?

A. I don't know whether the gentleman is "kidding" me or not, but Detroit ships very little hay to farmers. One of the problems, when we first start, is how two loads of hay are going to pass each other on our roads. For instance, on Michigan Ave., which at its widest point was only 16′, the two mythical loads of hay got by each other, and yet on the 24-ft. road which we have put there, the two mythical loads are having a bad time.

Q. We have a drainage proposition in Walton county, and the court prevented us from opening it up. The result was it went into winter quarters with ice on the ground. What will happen to that in the winter? Do you grade as you go along, and how heavy a grading do you have?

A. With reference to the first question I cannot say, but I shall be very much surprised if you do not develop quite a few cracks where your drainage is not properly taken care of. We grade ahead of our work as far as we can. We are in a valley and our country is flat, but the ordinary unimproved road follows the contour of the country up hill and down, not any very steep grades. The steepest grade on which we have laid concrete is 4%. The further ahead of the work the grading is done, the better the sub-grade, and the better the sub-grade the better the road.

Q. How deep a fill do you put in?

A. We have had two exceptional cases where we filled 15′. But there is a foot here, two feet there, and a foot and a half, and three feet and a few inches. It is hard to suggest to you any average.

Q. Do you put concrete right on that fill?

A. Yes, right on the fill.

Q. If you had a 15-ft. fill that ran off 150 ft., would you put concrete on that the same year?

A. No, I would not put it on until the next year.

Q. Doesn't concrete crack more in clay soil than in sand?

A. With the later work there has been very little cracking in either the clay or the sand. My idea is, based on experience, that without careful preparation of sub-grade we would have more cracks on the clay than on the sand. A sand sub-grade does not need the same careful preparation as a clay sub-grade.

Q. What is your opinion of the shape of the sub-grade—the way it ought to be?

A. We make it flat. We believe a flat sub-grade has a tendency to overcome frictional resistance and thereby decreases the development of cracks.

Q. Will you tell us of your experience with aggregate, and so forth?

A. Our first work was two-course work. The wearing surface was made with a very large aggregate—not because we believed in a large aggregate, but because we had it at the roadside. We had intended building a macadam road, and when we saw how our other macadam roads were wearing we felt it was uneconomical to haul it away and we used it. The surface consists of crushed cobble-stones 1" to 3", and it is too big. We now try to grade the stones to reduce the voids to a minimum. We aim to get the stones rather than the sand, to the top. The function of the sand, of course, is to fill the voids in the stone, and the function of the cement is to fill the voids in the sand and supply the bond. That is one reason we are so careful to keep the men off the concrete when it has once been placed. If they stamp on it they bring the neat cement and sand to the top. We are now using one-course work entirely. We found, with our two-course work, that while the material itself was cheaper, the additional labor and the additional care we had to put on it made it about the same price, and we believe if it is one class of material all the way through it is better quality.

Q. How do you tamp your concrete?

A. We do not tamp it.

Q. How do you get the air out of it?

A. With the handling it gets in dumping and in scraping over it with the template, I think there is very little air in it.

Q. Have you had conditions where you had to use reinforcing material?

A. I do not advocate the reinforcement of a concrete road under 20' in width. If you get above that, it is better to reinforce it. I think occasional cracks, even if one has to tear out a whole section, are more economical than spending 10 cts. or 12 cts. per yd. additional for reinforcement. We put down two or three sections reinforced with the joints 50' apart, purely as an experiment; we have not paid much attention to the result of the experiment.

Q. There is a peculiar condition in Minnesota, near Lake Minnetonka—a sort of pocket that continually sinks. It is probably a quarter of a mile long. For 20 years the county commissioners have filled it up with rock, sand and dirt of all kinds, but they have never been able to put anything down there that would stand up. Now they are figuring on putting a concrete road over that bog.

A. I believe I would use reinforcement if I were doing the work.

Q. Have you had any trouble with so-called blowouts?

A. No. Our pavement is 7" minimum thickness. We are going to cut it down a little this year. Of course, we are right next to a big city and our roads carry a tremendous traffic. Take, for instance, the traffic of a street 100' wide, and a continuation of the leading main paved retail street of a city of 600,000 inhabitants. The traffic, when it gets on to our country roads, is centered on 18' of concrete, and we thought we would better err a little on the side of safety instead of seeing on just how thin ice we could skim over. We have gone a little to the extreme as to thickness, and I do not believe it is necessary to build to as great thickness as we have. We are going to cut down to 6" at the side of a flat sub-grade with a ¼-in. crown, which will make it about 8" in the middle.

Q. How many miles does your program for 1913 include?

A. We are going to build all the mileage for which we can get materials, and we feel that we will have more money than we can build mileage, because of scarcity of material. I might state, in that connection, that we are not going to build anything but concrete in 1913.

Q. I am interested in the question of expansion joints. You were saying that you believed they were absolutely necessary. What experiments were made to determine that and the spacing finally adopted?

A. The spacing we finally adopted was simply an arbitrary distance.

Q. Opinions differ all over the country on the question of expansion joints on concrete roads. I have built some roads which did not have any. We let the cracks come where they would, and I cannot see that they are any the worse.

A. I believe it is better to have the cracks at regular intervals rather than in a haphazard way, and that it is better to have them protected than not protected.

Q. Yes, if you have them it is better to have them protected; but I was wondering if you had run any long stretches to see what would happen.

A. The detail of construction is based on observation of sidewalks and other concrete work. We tried to stay on the safe side and have erred on the side of safety as far as possible. It is no light matter to spend $500,000 to $600,000 of somebody's else money and live in the community afterwards. Mr. Butler, Mr. Haggerty and I do not make a living by putting in concrete roads or any other kind of roads in Wayne county. We get $5.00 per day, and I do not think any one would consider that we are overpaid. We have other business interests from which we earn a livelihood and we want to continue with those other interests.

You will realize that these details are processes of development. They did not all come in a minute. What one man did not think of, some other man did, and that has been one feature of the work. I do not mean the commissioners, I mean the man that worked the cement, the man that pushed the wheelbarrow, and the man that ran the level—it is the pride our men take in the work.

The work is of sufficient magnitude so that we can specialize. We put one crew on grading, one crew on concrete work, one crew on culvert work, one crew digging ditches, and so on. In that way we get more efficient service than if we attempted to use the same men on a number of different tasks.

Q. Where did you get water, along the line?

A. That is another one of the little economies we have worked out. For instance, on a section of the Grand River road the nearest available supply of water was six miles away. We laid a 2-in. pipe and used three gasoline engines to pump water to the work.

Q. How smooth is the surface?

A. We finish the surface with what looks like a very smooth coat, but, as a matter of fact, it is very gritty. It is not slippery in wet weather, unless the weather is cold enough to freeze; a coating of ice is slippery. When the pavement is wet it is not so slippery as creosoted block or asphalt, and compares favorably with brick.

F. P. Wilson[5]: I have been much interested this evening in Mr. Hines's talk, and the conclusion I have drawn is that he has put Wayne county on the map for country highways. In the past four or five years I have been in like occupation, trying to put the good old state of Iowa (especially Mason City) on the map, by constructing some of the best concrete pavements for city streets that can be found in the United States. In the past six or seven years I have made extensive investigations of concrete pavement for city streets, for roadways where there is light traffic, and for roadways where there is heavy traffic. I think a concrete pavement constructed with a good set of specifications, good cement, good, clean sand, good, hard stone, expansion joints at proper intervals, the sides of the expansion joints protected by soft steel protection plates, the sub-grade kept thoroughly dampened in the course of construction, the pavement after being completed being kept thoroughly wet at least 10 days, certainly warrants its use on city streets on account of its first cost, cheapness to maintain, and the cleanliness of the streets.

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[5] City Engineer, Mason City, Ia.

In 1909 Mason City constructed 10,000 sq. yds. of concrete pavement in the downtown district, where it would receive the heaviest traffic. At the present time, after standing the severe tests of the past two winters, it is in as good condition as the day it was put in. In 1910 Mason City constructed 25,000 sq. yds. of concrete pavement, both on residence and business streets. In 1911 50,000 sq. yds. were constructed. In the last year 52,000 sq. yds. were constructed, both in business and residence districts, at a cost of $1.08 per sq. yd., which includes the cost of excavating to a depth of 7", and the construction of a two-course concrete pavement of a total thickness of 7". The reason the two-course pavement was adopted in Mason City was on account of the softness of the limestone aggregate. The base of the concrete pavement consisted of 1 part of cement by measure, 2 parts of sand by measure, and 5 parts of crushed rock, the rock being crushed so that the largest fragments would pass through a 1½-in. ring. Immediately upon this base was placed a wearing surface 2" in thickness, consisting of 1 part of cement and 2 parts of screened sand. The sand we used in Mason City is shown, by analysis, to contain 80% granite. In constructing this pavement we first laid down 25' of concrete, and immediately on top of that was placed the wearing surface. The expansion joints were placed 37' 6" apart at right angles with the curbs, with blind or contraction joints every 12' 6", and steel reinforcement plates on either side of the expansion joints. These plates are practically the same as the Baker plate used by Mr. Hines.

The street pavements in the residence district are constructed 30' in width between curbs. In the business district some streets are paved 47' in width between curbs. On several streets in the downtown district there are street-car tracks. We pave the tracks with concrete just the same as if they were not there. We excavate a trench 14" in depth and 7' in width, which is thoroughly rolled and compacted with a 9-ton roller. Then the ties and rails are placed in position. We use 1 part of cement, 2 parts of sand, and 4 parts of crushed rock—an extremely wet mixture. This mixture is run in just the same as a floor-beam or column would be placed in a concrete structure or building. The ties are placed 30" o. c. Immediately after the concrete is placed we put a wearing surface of 2¼" in thickness of 1 part of cement and 2 parts of screened sand. We have a machine that cuts out a shape similar to nose brick for brick construction. We save $1.10 per sq. yd. between this class of construction and the same class of construction with a first-class paving brick. At the end of the ties we have a blind joint, so that the pavement proper is separate from the street-car track construction.

Within the past two years we have constructed in the neighborhood of 2,000 ft. of street-car track with concrete paving at $1.75 per sq. yd., and when I came away assistants in my office were making plans for 60,000 sq. yds. of concrete paving, a contract for which I expect will be let the middle of next month.

I visited Sioux Falls, S. D., this week, where plans are being made for ten miles of concrete paving, or about 200,000 sq. yds., a contract for which will be let in the near future.

F. E. Davidson: About eight years ago some concrete pavement was laid, under my direction, on 48th Ave., between 22nd St. and Ogden Ave., adjacent to the plant of the Western Electric Co. at Hawthorne, Ill. The equivalent of ¾ of a mile of pavement was also laid inside of the plant. Some of it was laid 10 years ago, some nine years ago, and some seven years ago. The construction was a 7-in. base of a 1:3:4 mixture of cement, torpedo sand, and stone, with a 2-in. top finish of a 1:2 mixture of cement and granite screenings. It was ruled off in brick squares. I saw the pavement about three weeks ago, and the wear in most places is hardly appreciable. Personally, I think that for medium weight traffic there is no pavement known today that is so satisfactory, so cleanly, so easy to repair, and so cheap as this form. The cost of the work was $1.80 per sq. yd. That included the preparation of the sub-grade and the complete finish.

Mr. Hines: I think it is safer for a while to let the pavement demonstrate itself on country roads and medium traffic streets rather court failures and kill the proposiiton. To me it seems like a commercial and an economical proposition. I can judge from the number of people who, through various influences, have come to Wayne county for information. If they were satisfied with the cost and the durability of the type of streets and roads that they had been building, they would not come 10 miles to 10,000 miles to see what we are doing in Wayne county. There are three things which most people think they can do better than anybody else—build a road, run a newspaper, and conduct a hotel. Until the general run of contractors and others interested in paving matters get away from the idea that the addition of a little cement and some water to some sand and stone makes concrete, I think it is safer to advocate the use of concrete pavement on streets of medium traffic and country roads, and when it proves its worth there, as I believe it will if properly constructed, then it is time to invade the heavy traffic streets.

I cannot see the object of putting cracks in the concrete. They simply gather dirt and thus cause more wear. The fewer the obstructions on a road of any type, the less wear there must necessarily be upon it, because with a wheel rolling smoothly over the road you do not get a drop. Even a small drop with a heavy load is bound to create a weak spot and an abrasion. I cannot understand why one should go to the expense of corrugating, because the pavement is not slippery. That is the only excuse I can see for corrugations.

Mr. Davidson: I want to add my observation on that class of work. I would never use anything but granite screenings or quartzite. I believe, with the speaker, in advocating a wet mixture for this class of work, but I should always use granite. I would not trust crushed stone or ordinary sand unless it contained a large percentage of granite.

A Guest: I have constructed concrete pavements on a city street where the grade was over 9% with a rough-cut finish without any corrugation. Another street had a 5½% grade without corrugation—just a rough flow finish. It was not so slippery as the adjoining street, a brick street of similar character, and adjacent to that was a creosoted block street where the horses could not stand at all.

Q. What do you think of oiling a concrete surface?

Mr. Hines: It is an unnecessary expense on our road, because the function of oil, as I understand it, is to lay the dust, and we have no dust.

J. S. McCullough[6]*:* I am glad to be here tonight to listen to the experience of others. This type of construction was started at Fond du Lac in 1908. The first season's work amounted to about 30,000 sq. yds. and each year since that time we have added to it, until we now have in the aggregate 140,000 sq. yds. of concrete. We started out by building plain concrete streets, using a local gravel and crushed stone. After the second season I concluded that our local gravel contained more clay than was beneficial, and for the last two years we have been shipping sand in from a pit about 40 miles from Fond du Lac and combining that with crushed limestone for a base. In the top we used equal parts of sand, granite, and cement, making a mixture that is 1 part cement, 1 part sand, and 1 part granite.

You may not agree with me, but I have an idea that by mixing the granite and the sand in equal parts the mixture is more gritty than with all granite. That is, after any wear takes place, I think with all sand the wear will be greater than if part of the top course is of granite, and with all granite in the top the surface will become more slippery. I think there is an opportunity to watch the difference in wear on the surface in the difference in the size of the aggregate. I know that Mr. Hines uses larger aggregate or the same size all the way through, and some of our neighboring cities in Wisconsin have been using up to ¾ in. granite in this top course with sand. Our granite is what is known in the market as Wisconsin Granite Co.'s No. 5. It runs from ¼" down to the finest with the dust out.

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[6] City Engineer, Fond du Lac, Wis.

For the past three seasons we have reinforced pavement slabs with American Steel & Wire Co.'s mesh[7], on account of development of cracks, which I attribute to the friction on the base and the concrete changing volume by heat and cold. The cracks have been very materially reduced in number, but have not been entirely eliminated; they do not open up, and if a crack does not open up it does not get a chance to ravel. On the oldest pavements we filled the cracks with asphalt and sand, similar to the method of Mr. Hines.

Mr. Hines: Does the asphalt stay in?

Mr. McCullough: It does if the crack is large enough to get it in.

Mr. Hines: We find the tar sticks better than the asphalt.

Mr. McCullough: I believe it would. The reason we used asphalt was because we had been using it to fill expansion joints.

There is one point about our work that I think could be improved upon, and that is, I think we have been making the joints we leave for expansion wider than necessary. We have been specifying a space 1" wide every 50', and if we reduced that by half its width I think it would be ample.

Mr. Hines: I think you are safe in reducing it to ¼".

The shrinkage of the concrete drying out, then the expansion that comes on it through the further expansion of moisture or heat and cold, which is very little, more than equalizes the shrinkage in the first place.

I might tell you how we came to use tar instead of asphalt. We tried the asphalt and found it did not stick well; then we used tar because there was a creosoted block pavement that abutted right up to our concrete on Woodward Ave., and about an inch of tar "boiled" out. It dropped off on to our concrete, making the concrete unsightly. I took some men out there one day and said, "We want to clean this off." They got scrapers and picks and one thing and another, and when I returned they were working on the first 25'. I said: "Let me show you." I worked half an hour and had moved a piece about as big as a dollar. So I concluded if it would stick that way without any preparation and without any cleaning off, it would stick well if we cleaned it off and made some preparation for it. Results have justified that conjecture.

Mr. McCullough: One of the remarks generally made in reference to concrete pavement is: "It must be difficult to cut through it." We have had more or less trouble along one of our paved streets where there is a street-car line, and the street-car company manages to cut through it with ordinary chisels for the purpose of renewing broken rails. A year ago the Wisconsin Telephone Co. wanted to do some conduit work in Fond du Lac, and the men were obliged to cut through several pavements, among them being a long stretch of concrete. They used a steam drill, the same type as is used in stone quarries—a small drill—and drilled holes about every 10" to 1' apart, alongside the gutter in a straight line, and broke the concrete out in slabs about 6' long with feathers and wedges. We took the slabs out to the park and used them in making a breakwater. The telephone company replaced the concrete with new material, and did not attempt to use the old over again by crushing it. They paid the contractor the price stipulated in the original contract for any trench work that became necessary within the five years of his guaranty, which price was $1.50 per sq. yd. They paved that and paid for all the filling up of the trench up to the concrete itself at their own expense. The work was actually put back, I understand, by the original contractor sub-letting it to a local man for about $1.25 per sq. yd. The telephone company, on the other hand, did some of the work on the brick streets with its own men at day-labor prices, and it cost two dollars and some odd cents per yd. to do the same work; that is, put in the concrete base and lay brick, and as many of the old brick were used as had not been broken in taking them out. There was considerable saving to the telephone company in replacing concrete over replacing brick.

H. J. Kuelling[8]*:* Milwaukee county is in its infancy in concrete road construction, and I came here to get pointers from some of my neighbors. The problem I had to face was a county where there were practically no roads except gravel roads. Last year we started with a sum of money amounting to about $250,000, and naturally we could not begin to spend it. I had a crew of men that knew nothing about the business. The first thing we did was to visit Wayne county and inspect the work there; then we patterned as nearly as we could after it, believing there was no necessity for going over the same ground they had.

Conditions in Milwaukee county are somewhat better than in Wayne county. Wisconsin, as you know, is well blessed in materials for concrete, especially certain sections, and Milwaukee county happens to be one of those sections. In some cases, however, the cement has to be hauled long distances, and our roads are not the best in the world.

In the last year we built about six miles of 18-ft. concrete roadway, besides some macadam and bituminous mixtures, but the coming season we expect to undertake the building of 30 miles of concrete roads. That is a large proposition for a little fellow in the second year of his life, and I do not know whether we can accomplish 30 miles or not. We are going to start off with a rush in the spring, whereas last year we did not have a yard of concrete down until Aug. 1. We had a new county board with 15 new members out of 19, and there was considerable delay in getting the work started. This year the surveying has been done. Out of the 85,000 yds. of material we have to move, I have already purchased 30,000 yds. or 40,000 yds. I am buying some of my material this year at 10 cts. per cu. yd.

The reason I asked Mr. Hines about grading is this: If we grade very far ahead and a rainy season comes, especially where it is a clay country, our work is delayed. So we aim to keep as close up to the grading line as possible. We have six miles of graded road that was left open for the winter, and if you could hear some of the criticisms we get for leaving that road open, you would not wonder that we try to keep up with the building gang. We have not had as good success as we should have had, for the reason that some joints were not put in as they should have been. We thought we could save money by attempting to select our gravel pits by the analysis of percentage of stone and sand. We made analyses, in a general way, but there are quite a number of errors in our first year's pavement, things I think we can avoid during the coming year by screening all gravel used.

We have tried bitulithic pavement to some extent and of the two we prefer the concrete. We built, last season, 30,000 yds. of bitulithic pavement; under it we placed a 5-in. base of concrete, and I believe it is more economical to add a little more to the concrete and let the concrete take the wear rather than go to additional expense for the 2½-in. binder and the cost of laying.

W. S. Shields: I have recently had the privilege of inspecting a stretch of country road just outside of the city of Mattoon, Ill. It was built under the specifications and direction of Claude L. James, city engineer of that city. The road is 9' wide and 6" thick, and was constructed at a cost of $0.76 per sq. yd., exclusive of the preparation of the foundation; ⅝-in. expansion joints were placed 50' apart, the edges of which were lined with paving blocks. Each alternate block being laid as headers gives a toothed effect.

The concrete mixture was 1:2:3, the cement to overfill the voids in sand by

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[7] Chicago, Ill.

[8] County Highway Commissioner, Milwaukee County, Wis.

5%, and the mortar to overfill the voids in stone by 10%; the stone varies in size from that passing a 2-in. ring to that rejected by a ¼-in. ring. The concrete was mixed wet enough to flush readily under light tamping, was distributed the full width of the paved portion of the roadway, and was protected from the weather until hardened.

The wearing surface consisted of a dry mixture composed of 1 part cement, ½ part of sand, and 1 part of crushed quartz, mixed dry and spread over the surface in sufficient quantity to take up the surplus moisture. The surface was then floated with a wooden floater to a proper form, and iregularities were brought to grade by filling with the wearing coat, which was required to be put in place within 30 min. after the concrete had been laid.

The road was standing up well under a heavy traffic and was attracting favorable attention.

A Guest: In view of the fact that we have had a little talk on concrete roadways and country roads, I simply wish to state that a little of that work has been done in the city of Chicago. This last year we put in one stretch 30′ wide by a little over 600′ long; the road is about 6″ thick throughout, composed of 1 part of cement to 2 parts of sand and 4 parts of gravel passing a 1-in. screen. There are no expansion joints except a ½-in. joint along the vertical concrete curb which we use, and every 12′ 6″ we have a contraction joint which approximates 1/16 in. That is to say, we put a thin strip of tar paper at the joint, our idea being that the concrete, when it is made in warm weather, surely has its maximum expansion at that time and tends to contract as it dries out under reduced temperature, and these joints are placed to allow of contraction. On that pavement we put ½ gal. bitumen and about ¼ in. of sand, because the pavement was very rough when the contractor, who was a novice, got through with it. It has a very good surface now.

I want to emphasize what Mr. Hines suggested of not going too far into the matter before it is demonstrated. On the street referred to we laid the concrete 2″ below the finished grade of a finished pavement, with the idea that if the pavement did not prove satisfactory we could put a 2-in. surface of asphalt on it, bituminous macadam, or concrete, and I think pavement could be laid in cities where people are timid about it, with the idea that if it is not a success it can be used as a concrete base.

Mr. Hines: As an experiment, we took a stretch of 1¾ miles of one of our first roads (which is not so satisfactory as roads we have since constructed, due to too much clay in the material—it was a screened instead of a washed product), and covered it with Dolarway[9], so-called. We were going to do the work so well that we overdid it, and used a little too much sand and a little too much tar, resulting in the pavement having a tendency to be wavy, the same as in asphalt pavements. We laid two or three short sections on other roads where we cut down the quantity of the tar, and obtained better results. I would advise any one, in attempting to put on a bituminous top, to be careful not to get it too thick, unless they go up to 2″—just a thin film. If the film is not thick enough it can be increased, but it is difficult to cut it down. If a concrete pavement is built that is a little rough, it can be saved by using it as a foundation, and it will remain there perpetually if it is properly kept up.

Sea Wall is Built of Concrete Units.

Where the Meon river flows into the Solent near the entrance to Southampton Water, a concrete sea-wall is being erected embodying many interesting features. The circumstances leading up to the construction and the construction itself are described in a recent issue of *Ferro-Concrete* (London).

A Concrete Sea-Wall Under Construction
Lee-on-Solent, England

For about three miles up the Meon river to the village of Titchfield, the meadow land on either side is low-lying, being well below high water of ordinary spring tides. As a protection against the inroads of the sea, a clay bank was constructed some hundreds of years ago across the lower end of the Meon valley. Like many sea walls, embankments and drainage works in this country, the bank was originally built by Dutchmen, and has been maintained down to the present day in its original form. Close to the Solent the river broadens into a sheet of water called Titchfield Haven, and discharges through sluices.

The face of the bank, which is situated in an exposed position, has hitherto been protected with timber sheet piling, but the heavy cost of annual repairs made it desirable to choose a more permanent type of construction.

Consequently, L. G. Mouchel & Partners, Westminster, London, were commissioned to prepare designs for the reinforced concrete wall now in course of construction. This consists of grooved reinforced concrete columns, each 9′ long by 14″ square and spaced 7′ apart, built up from concrete foundations. Between these columns reinforced concrete slabs, 12″ wide, tapering from 6″ to 14″ in thickness, are placed and grouted in the grooves, thus building up a perfectly water-tight wall. A steel-concrete buttress is attached to each column head and let into the clay bank, the lower end of each being terminated by a foundation block of plain concrete. The top of the wall is finished by a coping, about 6 ft. above high water level of ordinary spring tides, the beach having a gradient of about 1 in 15.

In the accompanying illustration, the upper view gives a general idea of the wall under construction and indicates plainly the rather dilapidated condition of the old timber structure. In the center is shown a detail view of the wall under construction. Below is shown the casting yard with some of the completed buttresses.

The engineer acting for the owner, Col. C. D. Radcliffe, is W. Butler, M. Inst. M. & C. E., and the contractor is F. Bevis, Portsmouth, Eng.

It was impossible to pass through the region of the spring floods in Ohio without noting remarkable examples of the permanence of concrete structures. One of the most remarkable examples was the Beaver Power Co.'s building at Dayton, which was in the path of the destructive fire which threatened to wipe out that portion of the city to which the residents had fled for safety from the flood. In the path of the flames was this one building. Its frame was of reinforced concrete, its window sash and its floors of concrete. There was nothing to catch fire. The building formed a perfect fire wall and prevented the spread of the flames. Had the floors been of wood joist construction it is probable that the flames would have passed through but, in spite of the concrete floors becoming so hot that water sprinkled on them turned to steam, the absence of inflammable material was a perfect check.

This building was completed in 1910 by the L. P. Hazen Co., Cincinnati, and was designed by Schenck & Williams, of Dayton. Universal Portland cement was used in its construction.

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[9] Dolarway Paving Co., 95 Liberty St., N. Y. C.

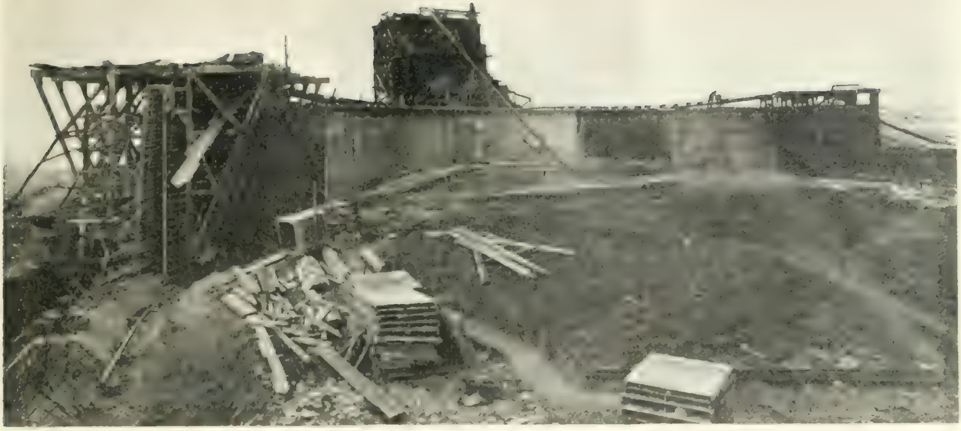

Fig. 1—Using Movable Steel Forms in the Construction of Reservoir Walls

Steel Forms for Concrete Construction

II. The Use of Large and Small Units in Building Walls, Columns, Girders, Etc.

BY WM. MAYO VENABLE*

[The first article of this series was published in CONCRETE-CEMENT AGE, Jan., 1913, and describes steel forms for sewers, aqueducts and tunnel construction. A subsequent article will deal with still further types of concrete construction.—EDITORS.]

Where walls are of uniform height and cross-section, and extend for great lengths, steel forms may be used with great advantage, because the same panels may be used over and over again many times, provided means is at hand for conveying them along the wall. This kind of work may be handled in a manner very similar to that described for larger sewer forms in the preceding article, namely, the forms may be mounted on carriers and conveyed along the wall, either one section past another section, or, as is more common, the form for a given section may be taken down and shifted into position for the adjoining section of wall.

Form units to be handled in this way may be made very large and mounted upon tracks, the tracks being located on both sides of the wall in most cases, although sometimes they may be mounted on one side of the wall only. The form itself may travel on wheels resting upon these tracks in a manner similar to that employed in building large sections of the N. Y. barge canal walls, or the forms may be suspended from a carrier, which straddles the wall, as shown in the accompanying illustration, which is a view of two traveling forms used in the construction of a reservoir wall at Parkersburg, W. Va. A very considerable amount of form work of this character has been done, the reservoir recently constructed at Toledo, O., in which the walls are of a very peculiar shape, being a notable example.

There can be no doubt that, where the quantity of work to be done is sufficient and the walls are of uniform height, this method of handling the form is the cheapest that can be employed, unless the nature of the work is such that a locomotive crane must run by the side of it for other purposes than that of handling the form, in which case the crane could be used to handle the form in large units without having to go to the expense of building a carrier.

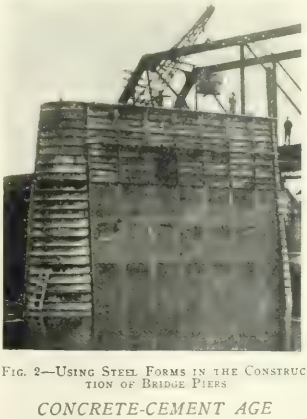

FIG. 2—USING STEEL FORMS IN THE CONSTRUCTION OF BRIDGE PIERS

Forms for this kind of work are usually made up in panels of standard unit dimensions and special panels are used to take care of special conditions, such as coping, water tables, etc. These panels are connected at their ends by means of staples and wedge fasteners to vertical angle irons, which are arranged in pairs, one attached to the edge of each panel. If the unit is 2'x5' for instance, a form is thus built up in units 5' wide and multiples of 2 ft. in height for any desired height and, as the 5 ft. widths may be connected together and left connected for any desired time, it is possible to shift panels of this kind in multiples of 5' in width and multiples of 2' in height of any size, so long as the weight does not exceed the capacity of the derrick available for handling.

An illustration given shows panels of this character employed in the construction of a large pier. In this case, instead of being shifted along the wall, the different sections of form are shifted up the wall. Special panels were used for the curved ends of the pier on the work illustrated.

Lighter Wall Forms for Walls of Varying Dimensions

Where it is not practicable to shift large units and where the work of erecting forms must for the most part be done by hand, lighter and more adaptable forms are required. Forms for this kind of work must be capable

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*Engr., Bldg. Dept., Blaw Steel Const. Co., Pittsburgh

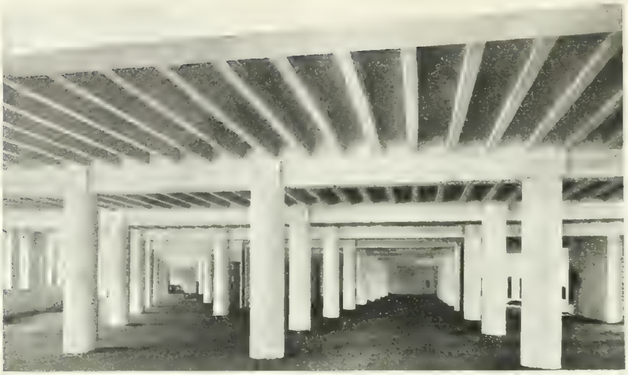


FIG. 3—A BEAM AND GIRDER FLOOR CONSTRUCTION IN WHICH STEEL FORMS WERE USED THROUGHOUT

of being shifted by hand, that is to say, the units into which the form may be separated should be of such size that one man can conveniently handle them, but at the same time it should be possible to connect together a number of these units into units of proper size for handling by power. The height of wall which is to be poured at one time and the distance apart of the ties or spacing bars which pass through the wall determine the weight of metal which is necessary to give a form of proper design the requisite strength. There are several designs of light wall forms for building work now obtainable. These are of two general types—one type consists of panels 2'x2', or thereabouts, there being approximately one wall tie for each panel or one tie to each 4 sq. ft. of surface of one side of the wall. This has been found a very convenient unit for handling, as a panel of the necessary strength for working in this way can easily be handled by one man. The number of ties is reasonable and the distance apart between the ties could only be increased by making the form heavier, so that it would be heavier to handle than the corresponding wooden form as ordinarily made. The number of ties through the wall with wall forms of this character is about the same or a little less than with wooden forms made in the ordinary ways.

In house construction what is known as the "two-course method" has proven very economical so far as the labor was concerned. In this method a form is provided for all of the walls of the house for a height of 4' only, this form consisting of two tiers each 2' wide. After 4' of concrete is poured, the bottom 2' of the form is removed, placed on top and filled, and the walls carried up in this way in 2-ft. lifts as high as desired. This method is adapted for building walls with comparatively little reinforcing metal, where most of the metal runs in a horizontal direction and where the rate of construction is comparatively moderate. It requires an exceedingly small quantity of form, which is its chief advantage, because an investment in forms sufficient to build ordinary houses in this way is not so great as to be beyond the reach of the ordinary house builder.

Another method for constructing walls for buildings and residences is to erect forms for one story at a time and to pour an entire story complete, including the floor for the story above, if that is of fireproof construction. When one story has been completed, the second story is begun either with the same set of forms or with another set, according to the time which the forms are to be left in place. This is the method which is ordinarily employed on large building construction where wooden forms are used. It requires a larger equipment of forms, but it has the advantage of permitting the contractor to place all of his reinforcing metal before he begins to pour concrete, which is a very great advantage on large work. Pouring one story at a time on residence work presents some decided advantages where the scale upon which operations are conducted is sufficiently large. When one story is to be poured at a time, it is a distinct advantage to have the panels of the forms the full height of one story instead of connecting together a number of panels to make up the necessary height. It must be remembered on the other hand that forms which are designed especially for single story heights cannot be used with equal advantage on larger story heights, whereas the smaller units may be so arranged that they can be employed for buildings, no matter what the story heights may be.

A few words about the use of concrete in house construction may not be out of place here, although house construction involves many problems other than that of the forms. The form cost on residence construction, where buildings are designed with special reference to keeping the form cost within reason, may be reduced to such a figure as to make practicable the building of concrete houses for ordinary everyday use. In fact, such houses may be built at about the cost of good frame houses. The question of their introduction on a larger scale does not turn upon the practicability of reducing the form cost but upon the question of constructing houses in such a way that they will be, at all times dry and comfortable and, at the same time, keeping their cost low. A solid-wall concrete house is suitable if the walls are thick enough, in any climate, but the thickness of the wall to make such a house free from condensation in northern climates is rather great and perhaps it is not safe to build solid-wall concrete houses with walls less than 9" thick in the northern part of the U. S. and expect them to be dry, while a solid wall 6" thick might be reasonably dry, if well constructed, south of Mason and Dixon's Line, and thinner walls than this would be suitable, so far as weather-resisting properties are concerned, in the extreme South. It may be said, however, that 6-in. and 9-in. walls if furred on the inside, will give complete satisfaction in almost any climate, as the furring will prevent surface condensation on the inside owing to the difference in temperature of the inside and outside and the presence of more water in the atmosphere indoors.

Of course, furring adds to the cost of the house, but the builder should not deceive himself into thinking that he can build a concrete house that will be better than the best possible frame or brick house and get the work done for less money; and if he tries to keep his cost down by omitting the necessary precautions in interior finish he will not get satisfactory results.

The hollow wall aims to accomplish the results of furring and plastering without going to the expense of having to lath and plaster. A poured concrete house may be constructed with air spaces in the walls by the use of cores, and a house constructed in this way may be decorated on the inside of the concrete without the necessity of plaster if a finish of this character will be satisfactory to the tenant. Such a house is as dry as one which has been furred and as dry as any house that may be built, and it can be built at the lowest price that is consistent with constructing a solid masonry house that will be proof against the weather. Hollow walls, 9" thick over all, contain a quantity of concrete about equivalent to that in the 6-in. solid wall, and cost but a trifle more to build, and do not require furring in the interior to prevent condensation.

Column Molds

In large reinforced concrete building work, the columns were generally made, until very recently, of rectangular or octagonal shape throughout and wooden forms employed, the forms for the columns likewise serving to support the ends of the forms for girders and beams. In the earlier works, these wooden column molds were held together with wooden column clamps, but recently there have been substituted for the wooden column clamps steel column clamps of which there are several designs now on the market.

The circular columns came first into

extensive use in connection with flat slab construction, and circular columns have, for the most part, been made with metal molds, the simplest molds for this kind of work consisting of two semi-circular forms of the height of the column with flange at their vertical edges by which they were bolted together. These forms were not adjustable either as to height or as to diameter and, while such forms may be made with comparative convenience, the fact that they can be used only on one floor of a building makes the cost exceedingly high. There are two types of adjustable circular column molds now in use. One of these types is made adjustable by lapping sheets of galvanized metal upon one another and joining them together with stove bolts until a large sheet of the proper size for forming a column has been made, wrapping this sheet around the column reinforcing and securing it with bands, of which a set is furnished for each diameter. The peculiar features of a mold of this character are concerned with the method of securing the bands and the methods of making connections between the column mold and the floor slab. In another system of column molds, the panels, instead of being lapped upon one another and bolted together to form a band of the proper width, are of fixed width, their edges being bent back to form flanges through which sectional bands are passed. These bands are drawn tightly together by means of wedges so that the column mold when assembled resembles a stave pipe with rigid bands, it being as tight as a barrel. These molds are adjustable as to diameter by changing the number of panels or staves of which they are composed, these panels being sufficiently flexible to be used for all diameters, the bands only requiring to be changed. These molds are adjustable as to height by telescopic movement and when assembled are very accurate, and produce extremely smooth and true columns. The accompanying illustration shows a number of columns in the new warehouse of the International Harvester Co., where these molds have recently been employed.

Similar principles are employed in the construction of adjustable rectangular column molds for building construction. It is but a matter of a short time before the use of wood, on column construction, will be very greatly reduced and steel molds substituted therefor. The secret of commercial success in the use of steel for forms in building construction lies in the adjustability and adaptability of the mold, it being necessary that a column mold be capable of being used on all of the different floors of a building, no matter what the floor heights or the dimensions of the columns may be, without any cutting or any waste, and that they shall be available for future work of similar character. In other words, since the wooden molds wear out in a very short time and have constantly to be re-built to conform to new dimensions, and the steel molds do not wear out and are adjustable to a wide range of dimensions and can also be handled more cheaply than the wooden molds, the steel mold will inevitably displace the wooden mold in the hands of all of those who are permanently engaged in the business and, therefore, can afford to distribute their form cost over more than one or two floors in a building. The cost of an equipment of column molds for a given job is remarkably small, for it must be remembered that where steel molds are used for the columns the load of the forms for beams and girders is not carried on the column mold but upon other shores and, consequently, the column molds may be taken down and used over again much more rapidly than is possible under the old system, which means that a much smaller number of molds is required to do a given piece of work.

Ceiling Construction

As stated in the previous article, corrugated iron has been used for a long time for supporting floor slabs. The best size to use for this work is No. 20; this can be obtained in sheets of various widths and lengths at very moderate prices. It is not necessary to use galvanized material—the sheets are merely laid down and tacked to their supports, the spacing of which is a matter amenable to calculation. Where corrugated sheets are employed, the sheets must lap one another the width of the corrugation and, consequently, in order cover a given area the adjustment can only be to within about 2½ in., which is the width of the lap. Corrugated iron may be used for floor slabs either flat slab construction or beam and girder construction. Of course the corrugations leave their impress upon the ceiling, which in many cases in warehouse work is not objectionable. For the most part, where plain surfaces are required, steel forms have not displaced wood for slab construction because of the large amount of surface which must be provided for at one time to support the ceilings and the length of time the the forms must be left in place. This makes the investment in ceiling forms very high if the first cost materially exceeds the cost of lumber. The cost of corrugated iron exceeds but little, if any, the cost of the lumber it displaces, but the cost of a fabricated steel form is materially greater and requires that the work be laid out in such a manner as to permit the use of the form a greater number of times than is ordinarily contemplated where wooden forms are employed. Nevertheless there are many cases where the use of steel forms for ceiling support is very economical. The light wall forms, described previously in this article, are quite extensively used for ceiling construction where the spans are not great and the length of time that the panels are left in place is moderate. The type of construction shown in the illustration of the interior of the International Harvester Co.'s building affords an extremely economical design for the employment of another type of steel forms for the ceiling. The cost of steel forms for the slabs and beams there shown is less than the cost of the necessary equipment of wooden forms to do the same work, and the cost of handling and collapsing the steel forms very much less. There are other types of ceiling construction upon which steel forms may be used with advantage, but in general it may be said that each type of ceiling construction must be considered by itself, as no form has ever been devised which will take care of all conditions of ceiling construction more economically than they can be taken care of with wood.

Beams and Girders

Many attempts have been made to devise steel forms for beams and girders that will be adjustable and adaptable to all dimensions occurring in a given building. This is a very difficult problem and as yet it has not been successfully solved. It is, however, practicable to make beam and girder molds entirely of steel and adjustable to within reasonable limits, so that in very many cases it is more economical to employ steel molds for beam and girder construction than to employ wood.

This is especially the case when the length of the spans is the same on many floors in succession, as the difficulty in adjusting the length of beam and girder molds is the principal difficulty to be encountered in that kind of work, on reinforced concrete construction. In fireproofing steel buildings with concrete, however, completely successful molds for the beams and girders have been worked out because in this case the structural steel already in place supplies the necessary longitudinal stiffness for a mold made of several parts.

Concluding the discussion of the use of steel forms on building construction, a brief summary may be of interest. In general, it may be said that the use of steel column molds will always be profitable to the builder regularly engaged in the business, and frequently profitable to the owner doing his own work. The use of steel wall forms will be profitable to all builders who have a considerable number of foundations to construct in succession and to all of those who have concrete superstructure walls to build where there is an opportunity for repeated use of the forms. This practically means that the wall forms will pay their own way in one season where the users are in the right line of business and they will often pay their own way on one job where the job is large enough. The ceiling construction is one requiring special study in each case, some types of construction being handled more economically with steel than with wood, if there is opportunity for re-use of the panels on floor after floor. However, it will doubtless be found that the increase of the use of steel forms for ceiling construction as well as wall construction will be rapid.

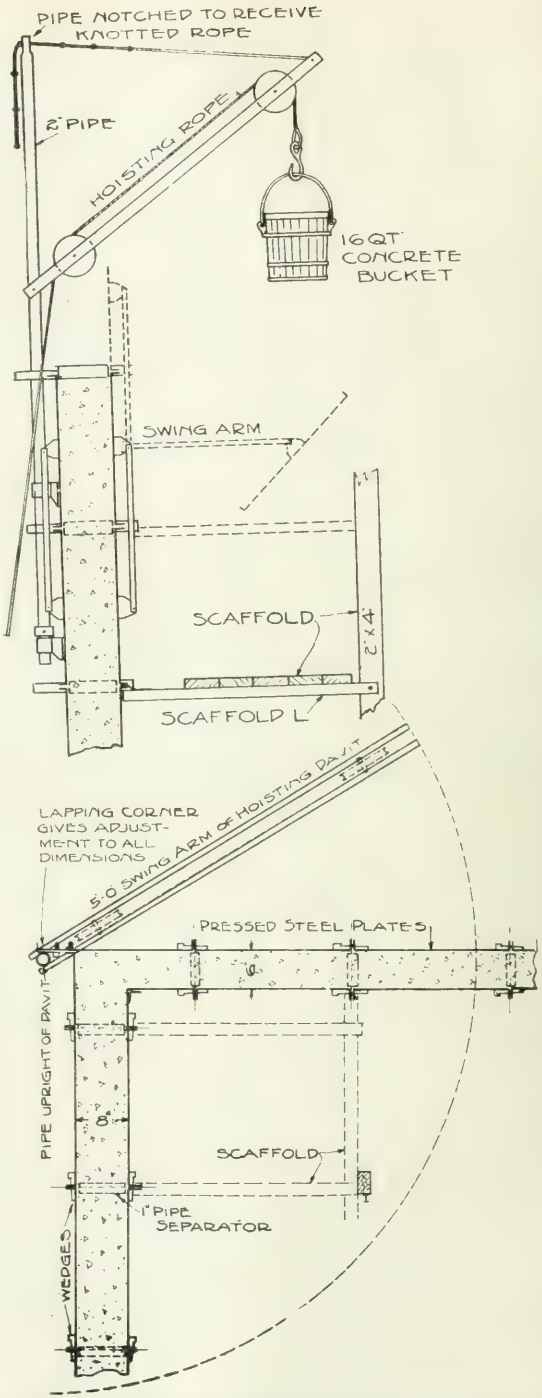
Hoisting and Placing Concrete at Low Cost

BY MILTON DANA MORRILL*

On large buildings with present methods, concrete is being raised and placed at low yardage cost. The most modern method is by spouting with the use of a tower and metal or wooden troughs. While this is of advantage on work where the yardage is great, such a method cannot be applied with economy to residence work, silos or other structures with thin walls and where the amount of concrete to be poured is comparatively small, because the spouting system entails a somewhat elaborate and costly equipment, and the transfer or movement of the spouts to deliver concrete at the various parts of the building oftentimes brings the placing cost to a prohibitive figure.

A simple inexpensive equipment, cutting out elaborate machinery would seem necessary, and we have devised and developed on our work a simple hoisting davit which seems to fill a considerable need in the lighter forms of buildings. This davit is illustrated by sketches shown herewith.

Fig. 1 shows in plan a corner section of the steel forms and the position of the davit, as an attachment to be moved or raised as the work progresses. A 2-in. pipe upright is clamped by wedge connections to the corner plates, being arranged to swivel and to turn easily. A swinging boom is attached to this pipe upright, or boom, made up of two light channels with ball-bearing sheaves for hoisting rope. From the end of this swing arm, a knotted rope or guy passes through the notched head of the pipe, permitting the lowering or raising of the arm or boom. This davit swings out over the mixing board or to the mixer. The heavy 16-qt. sewer buckets are filled and hoisted, and after the davit is swung to the desired point the concrete is dumped into the forms. The hoisting rope passes through a snatch block pulley attached near the ground; the bucket is raised by hand by a friction drum on the mixer or by horse. After the pouring is completed at one point, this davit, being attachable at any point, is unclamped and moved. This hoist is of such a simple inexpensive type that several of these davits can be utilized if desired, simultaneously, raising the concrete at various points.



Plan and Elevation Detail Showing Arrangement of Light Hoisting Davit Bolted to Form Work

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Roofing Tile in Canal Zone

The American Cement Tile Mfg. Co. has a force of seven white Americans and 38 negroes engaged at Paraiso, C. Z., in the manufacture of roofing tile for the terminal buildings at Balboa. About ⅛ of the quantity has been completed and is in storage. A test was recently made for the purpose of determining the breaking load and strength per square foot, and the results show that the tile is well above the stipulations of the contract with the company.

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*Reed & Morrill, Brooklyn

Field Made Plaster Cores for Floor Work

BY FREDERICK SQUIRES*

I have often noticed in looking over the various methods to provide forms for cross-wise reinforcement, that the problem seems to have been approached almost entirely from the point of view of a one-way reinforcement and some clever method of deriving a two-way system from it. This is especially noticeable in the hollow tile schemes, which were brought to quite a degree of perfection before the two-way method was attempted at all. I think there must be at least 10 patents on closing the ends of hollow tile blocks so that the cross-wise beam may be formed, and there are two or three patents under which the cross-wise beam is poured directly against the open ends of the tiles. However cleverly these matters were handled, they always seemed to be more or less of a makeshift. Further study of hollow tile manufacture showed that the character of this product was practically settled. Searching around for a material which should not have limitations, I ran across the sand molding process, a description of which has appeared in these pages.[1] While experimenting with it I went through the whole range of molding materials and in this way became acquainted with gypsum from which the "pyroblock," as we have called the cores, is made. I found immediately that it was subject to none of the limitations as a form for cross-wise reinforcement that were inherent in hollow tile.

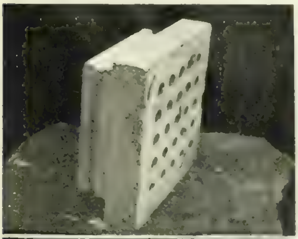


FIG. 1 (ABOVE)—SHOWS THE FIRST MODEL OF PLASTER FLOOR CORE CAST

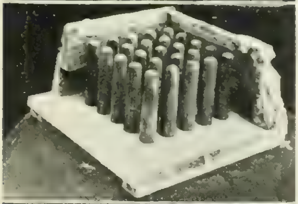


FIG. 2 (CENTER)—THE MOLD USED IN THE FIRST EXPERIMENTS ON PLASTER FLOOR CORES

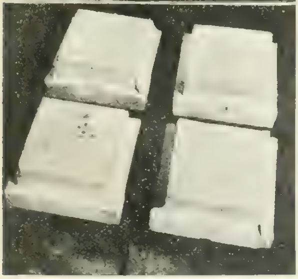
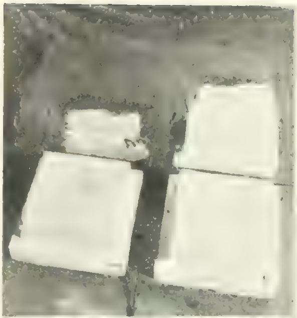


FIG. 3 (BELOW)—THE WAY IN WHICH PLASTER FLOOR BLOCK ARE PLACED IN THE FLOOR

For those few readers of CONCRETE-CEMENT AGE who know as little about developments in slab construction as I did but a few years ago, I will briefly explain that flat slab construction with two sets of reinforcement at right angles to each other has the advantage of distributing the floor load to all four edges of the slab. As a solid slab it has the disadvantage of wasting concrete in the lower half due to the fact that this part of the concrete mass, which is below the neutral axis, is in tension, a stress which concrete has little power to resist and which must be taken up by the steel reinforcement. Roughly speaking, concrete takes care of the compression which occurs above the neutral axis and steel takes care of the tension which occurs below the neutral axis, but the volume of the concrete is nearly 100 times as great as the volume of the steel. It is therefore unquestionably economical to honey-comb, as it were, the undersurface of the slab in order to put the materials in their best position to do their work. A merely honey-combed under surface is objectionable on the ground that it may not be plastered economically or even formed in concrete economically, a level plastered ceiling being the desired condition. In order to maintain the advantage of distributing the load to all four supports of the floor panel and to get rid of the waste of concrete in the lower half, the system of forming transverse beams and a top slab around and over permanent forms has been developed, the permanent forms providing also a level plaster surface. There are several well-known methods of using tile producing this result.



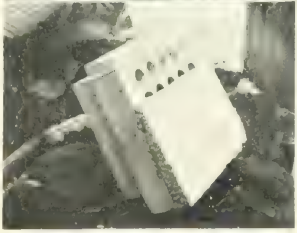


FIG. 4 (ABOVE)—THE CONCRETE PARTLY PLACED
FIG. 5 (BELOW)—THE UNDER SURFACE OF THE PLASTER BLOCK SHOWING THE WAY IN WHICH THE KEY FOR PLASTER IS DEVELOPED

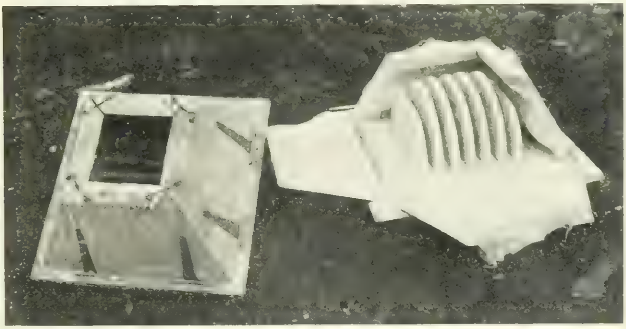


FIG. 6—AT THE LEFT IS SHOWN THE MOLD FOR THE PLASTER BLOCK CLOSED; AT THE LEFT IS SHOWN THE SAME MOLD OPEN

As I have said before, the first thing I tried to get away from in these experiments was the conversion of a one-way system into a two-way system. I wanted to start with the problem of producing a perfect two-way system. Finding that the method of manufacure precluded clay tile because it is essentially

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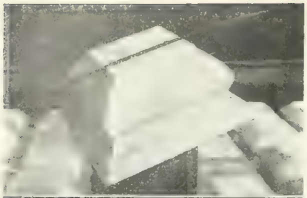
*Squires and Wendehack, Archs., N. Y. C.

[1] Molding Sand Cores for Floor Construction by Frederick Squires, p. 213, May, 1913, issue



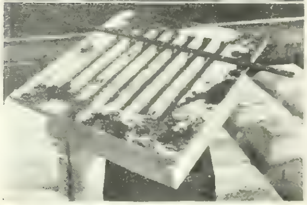


Fig. 7 (Above)—This Shows the Type of "Pyroblock" as Finally Used, and as Made in the Mold Shown in Figs. 5 and 6
Fig. 8 (Below)—This Shows the Under Side of the Same Plaster Block

a one-way method of manufacture, I obtained my first real start from the use of molding sand. It is harder to make a good one-way system out of molding sand than it is a two-way. Having thrown away tradition in the method of assembling my forms and having found a material which could take any form, it then seemed important to work, not on the material of the forms but on the best shape that the concrete could take. I was confident that this would not be the outline shown in the existing two-way systems which would unquestionably be as closely tied down by the character of the materials as they were in the assembling of the parts. It seemed apparent also that the outline of the concrete beam in which the area of the material in compression is so much greater than the area of the material in tension, could be nothing like the outline of a wooden or an iron beam with a homogeneous cross-section and uniform stress areas. If I could settle what this outline should be I had a plastic material which I could make conform to it. Asher Atkinson, a N. Y. engineer, plotted the outline of a concrete beam as a double parabolic curve, starting a little below the reinforcement and rising on each side until it met the top slab. He modified this slightly to take a mean course between this curve and an ellipse having the same axes, so as to take care of concentrated loads. This line is a far cry from anything that can be made up out of hollow tile blocks but is a perfectly easy thing to obtain in gypsum.

Fig. 1 shows the first "pyroblock" ever cast. Its outline was not carefully studied, the object being merely to studv the material along the lines of producing a hollow block and the action of concrete upon it. This was cast in the mold shown in Fig. 2, two sides and the top of which have been removed so that the fingers could be shown in the illustration. The purpose of these fingers was to make a honey-combed block which would have the advantage of being light and which could be plaster as is shown in Fig. 5. They are shown in the position they would take in a slab in Fig. 3 and with the concrete partly poured in Fig. 4. The block is easily channeled on its lower surface for electric conduits and may be cut to fit around pipes, masonry walls, columns, or any other obstructions. Concrete did not affect it but on the other hand it seemed desirable to obtain a sure mechanical bond between the gypsum and the concrete. Each being a material

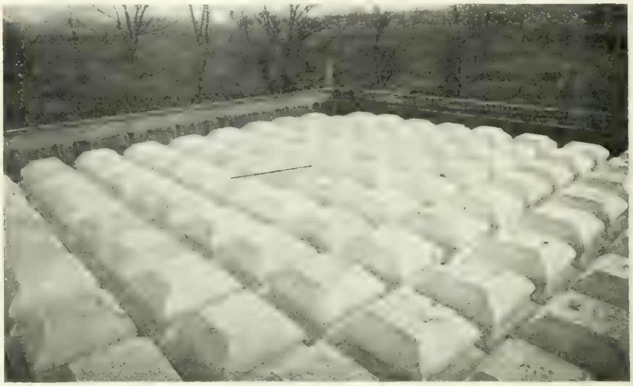


Fig. 9—The Plaster Blocks in Place Ready for the Steel and Concrete

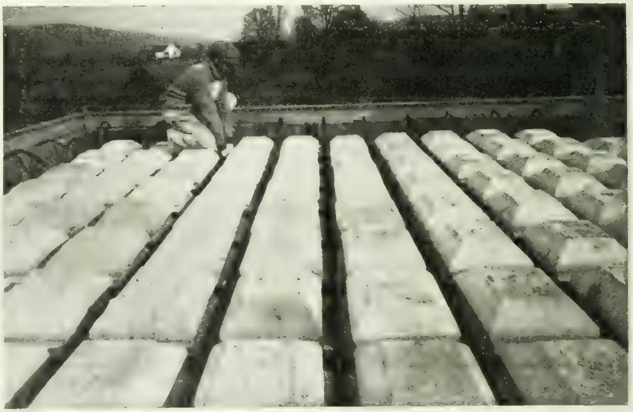


Fig. 10—The Steel in Place Ready for the Concrete

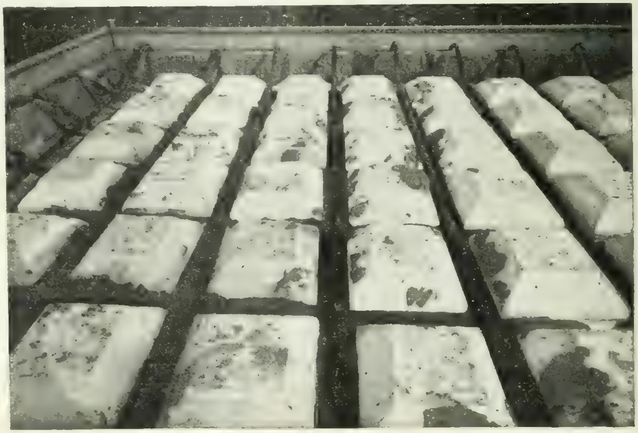


Fig. 11—Placing the Concrete, the Steel Partly Covered

that goes through the stages of fluidity and afterwards sets up hard, a mechanical bond between them was one of the simplest things to obtain.

Having gone through these experiments and being convinced that there was a chance for "pyroblock" as a fireproof mold for concrete, there remained only to build it into an actual operation. We knew that plaster had been used as a mold for the most delicate kinds of ornamental concrete work so we knew there would be no difficulties from shrinkage of the form in a big slab. It was at Oakland, N. J., that the first opportunity came to use "pyroblock" in a fireproof building. We shipped the material to the site and with it the blue print from which were made the molds shown in Fig. 6. There were four of these made at a total cost of $25. They were all the machinery used for making "pyroblocks." Two Italian laborers turned out at the rate of 120 a day, the "pyroblock" shown from top and bottom in Figs. 7 and 8. It will be noted in Fig. 7 that the block far more nearly approaches the parabolic curve recommended by the engineer. The mechanical bond is produced by an inward sweep near the bottom of the block at the point where the bar will come when the block is put on the form and serves the double purpose of binding the "pyroblock" into the concrete slab and of surrounding the bar with a plentiful amount of concrete. Fig. 8 shows the lath effect which may be readily plastered. In our later work, however, this block was dipped on the ground so that the slots were closed and the block required only a white coat after it had become a part of the ceiling. The centering required is very open and obviously inexpensive. Fig 9 shows the blocks on the forms before the rods have been put in and Fig 10 shows the rods in position. These blocks proved to be very strong and were not affected at all by the walking and trucking which took place on them. They were well aligned, the reason for which may be readily seen by glancing back at Figs. 7 and 8. Since all the blocks were made bottom down in the same mold, they must necessarily be perfectly true on all their edges and surfaces so that when they are put edge to edge on the forms one cannot be moved without moving them all. For this reason the concreting was easy and sure. Fig. 12 shows the concrete over the top. As we showed in an earlier photograph, "pyroblock" holds nails well and we have cast floors in which concrete was brought only up to the level of the top of the block and the rough floor nailed directly to it. This is possible, of course, only because of that other quality of the "pyroblock" that it can be grooved on the underside for electrical conduits. If it were necessary to put these conduits on the top of the slab it would also have been necessary to provide sleepers and fill, as in the usual construction. This feature of the material saved 2" to 3" in the thickness of the slab. After the forms were taken down a plaster ceiling was presented by the blocks themselves which was finished with a very thin coat of plaster.

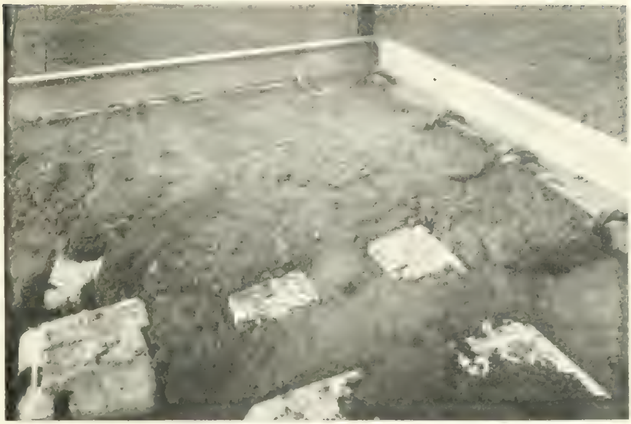


FIG. 12. A [illegible] [illegible] FLOOR, PYROBLOCKS COMPLETED

The main advantage which appears in this construction is its cheapness, which is due to a number of reasons. In the first place the materials are shipped in bulk to the site, a very economical procedure; the molds are very simple and have a very low first cost, the mixing of sand and gypsum is known to thousand of laborers, the pouring of the liquid gypsum into the mold and the opening of the mold eight minutes later is a fool-proof operation. The fact that the gypsum sets up quickly is the salvation of the whole scheme; four molds will keep two men busy and two men can turn out 150 a day. The type of labor that knows enough to go in when it rains has all the intelligence required.

The form work for "pyroblocks" consists only of 3-in. x 4-in. joists at the junction of each row, supported in turn on 2-in. x 10-in. stringers about 5 ft. o. c. running in the opposite direction. The blocks line up so true that there is no waste of concrete through the joints, which makes for economy in that material. A ceiling such as is shown in the illustration and more particularly a ceiling where an entire gypsum surface is presented is the most economical kind of a surface to plaster on. It is literally a plastered ceiling before the plastering is begun. An ornamental coffered ceiling of any degree of elaboration may be obtained by casting "pyroblock" in an ornamental mold, but I have been an architect long enough to know that anything which attempts to aspire towards beauty is writing its own death-warrant when it tries to obtrude itself into an engineering proposition such as is a concrete floor mold, so that we will hastily withdraw this suggestion.

We have now gotten back to the point from which we set out. We have a form which fits an engineering theory. To the best of our knowledge the beam is exactly what we were told to produce. The form is a form. The tile form has to be apologized for and explained. One has to say that it comes *near* to the theoretical outline or try to demonstrate that a collection of warped and broken terra cotta pieces obtruding themselves into the compressive area of concrete strengthens that area. If the form be metal and it is criticised as detrimental to the fireproof quality of the floor, one has to argue that the concrete doesn't need fireproofing and that the metal in expanding isn't strong enough to wreck the slab. In other words it takes a good explainer to get away with some of the present day form methods.

The "pyroblock" starts with the theory and modestly conforms itself to it. Having conformed to the theory, it must be that the concrete is exactly where it belongs and that the minimum of concrete is doing the maximum of work. The fact that the mechanical bond and the reinforcement occur at the same point is mutually advantageous. We believe that gypsum is good fire-proofing. It pretty generally is accepted in partitions but it will be better established after a fire test has been made on one of the "pyroblock" ceilings recently constructed.

I would say in closing that it has long been considered good engineering to reinforce a concrete slab by rods laid at right angles to each other in order to carry the load to all its supports and it has long been known that such a slab could be improved by cutting out the idle concrete in the lower position. The forms to do this work had suffered much in efficiency on account of the physical limitations of the materials of which they were made and it was not until "pyroblock" was developed that a form was found which would perfectly section the resulting crossed beams. One of the requirements was a flat plaster ceiling and the "pyroblock" is plaster. It is easy to make and easy to use and both in manufacture and in concreting it spells "economy."

Reform in Construction Specification Practice

Recent heavy losses in building operations by contractors, owners and surety companies have caused men interested in this line to investigate carefully the causes responsible for these conditions. The result of this investigation indicates that there are two principal underlying causes.

First: The lack of clear, accurate and standard conditions and detail description in preparing plans and specifications.

Second: To make the architect and engineer the final judge of all matters, including his own acts, often destroys incentive to faithful service and prevents careful preparation of specifications and plans, since he is not held responsible for errors, being the final judge of them. As a remedy, five propositions are submitted, as follows:

To define accurately and to standardize, wherever practicable, plans and specifications in order to eliminate unnecessary hazards and uncertainties in construction contracts;

To reduce the cost of improvement to the owner;

To give the contractors and surety companies a proper understanding of the obligations they assume;

To establish contracting and suretyship on a more stable and definite basis;

To provide for the settlement of differences by some equitable, constituted authority.

A well-known writer on this subject explains that:

> The present system employed in the preparation of contracts and specifications is a relic of antiquity, and is an outgrowth of the practice years ago when the builder was merely a mechanic, working under the personal direction of the engineer or architect, where small amounts of money were involved. Under these circumstances, the contractor was practically, if not actually, the employee of the owner.
>
> This is the day of heavy contracting operations, where large amounts of capital are involved, and yet we are attempting to proceed under obsolete methods which were possibly sufficient for primitive conditions, but absolutely inadequate and out of date now.

The following is quoted from an article read before the Am. Soc. of Engrg. Contractors by Wm. B. King, attorney, Washington, D. C.:

> 1. Every contract should define as accurately as possible the exact work to be done and the exact compensation to be given, leaving as few contingencies as the nature of the work will permit.
>
> 2. Each party should assume the responsibility for his own conduct and for conditions within his own control.
>
> 3. The provisions of the contract should be drawn so as to do equal justice to each party.
>
> 4. A fair and prompt mode of adjusting disputes which may arise during the execution of the contract should be provided.

A contract is defined by Blackstone to be "an agreement upon sufficient consideration to do or not to do a particular thing." Agreements which leave so much to the discretion of the engineer or architect are not agreements "to do a particular thing" and are therefore lacking in one of the fundamentals of the contract as here defined.

It has been frequently pointed out that these discretionary contracts may be used to destroy the first essential of competitive bidding.

It is manifestly unfair that the rights of a contractor should be so dependent upon any person representing and employed by the other party to the contract. This has been admirably said by Onward Bates, C. E.:

> "The contract almost invariably provides that the engineer for the party paying for the work or material shall be the sole judge of the sufficiency and quality of the work and material furnished by the other party to the contract; that all controversies arising under the contract shall be submitted to him for decision, and that his decision shall be final and binding on the contractor. This reads like foolishness and yet it is a common stipulation in an engineering contract. It seems as if engineers and lawyers had conspired together to formulate contracts giving the engineer arbitrary power over the contractor," and very properly could be added, arbitrary power over the owner.

The first essential of a specification is that the exact work to be done shall be precisely defined; but many deal in generalities and comprehensive clauses, failing to state specifically the actual amount of work to be done or the exact nature of the obligation to be assumed. This leaves many items in the specifications to be further construed, and the architect or engineer may be a "loose constructionist," in which case undue liberties may be taken with the contractor or owner, and often this is carried to great abuse.

Specifications invariably err in the direction of vesting too large a discretion in the architect or engineer and in containing too many omnibus discretionary clauses. It may well be said that he holds in his hand the solvency of the contractor.

Specifications should be made certain in their provisions and individual discretionary powers should be curtailed; the final exercise of discretionary authority should be vested in an impartial tribunal.

It is not unusual to find conditions in plans and specifications that can be enforced in such a manner as to make the work impossible of execution, or its cost prohibitive. These conditions make the successful performance of the contract dependent wholly upon the fairness and good judgment of the architect and engineer, or his disposition toward the contractor. This state of affairs is often the occasion for oppression and corrupt practice and is generally unsatisfactory.

Contractors should have representation. Either party should be able to bring questions involving the exercise of discretion under the contract before a tribunal of arbitration where the rights of both parties will be looked upon from an equal standpoint.

Analyze and consider this condition. Would competent business men in other lines of business agree to such a condition? To make matters worse, practically unlimited authority is often placed in the hands of architects of very limited experience.

It is thus important that all contractors and owners should unite in endeavoring to remove from contracts and specifications the unlimited discretion of the architect and engineer and to insert in them a just method of settling disputes.

These propositions have been endorsed by the surety agents of several states; by builders, in national conventions; by a very large number of owners who have had experience in building; and by financial institutions, investing in building securities. Recently the Surety Association of America, in session, appointed a committee to meet with a committee of the National Building Trades and Employers' Association, and a committee of the American Society of Contracting Engineers, with a view to taking immediate steps to enforce these five propositions. These committees will meet together at an early date.

This matter is of the utmost importance to the building business and should receive the careful and earnest consideration of all parties affected. Suggestions and discussion of this subject are invited.

Raw Material for Portland Cement

A bbl. of Portland cement will consume about 450 lbs. of limestone and 150 lbs. of clay or shale. A plant making 1,000 bbls. a day will therefore use, in the course of an ordinary year, about 66,000 tons of limestone and 22,000 tons of clay or shale. Assuming average density for these materials, a 1,000-bbl. plant will use up almost 1,000,000 cu. ft. of limestone a year, together with 250,000 cu. ft. of shale.

As the investment in plant is heavy, it would be folly to locate a cement plant, under ordinary circumstances, at a point where less than 20 years' supply of raw materials is in sight. A 1000-bbl. plant, therefore, should have 20,000,000 cu. ft. of limestone and 5,000,000 cu. ft. of clay or shale on its properties.

Information and Consultation

The Questions and Discussions in this Department are of interest and real value. Speaking for our questioners, we earnestly ask readers to discuss the questions submitted. For men in field and office, let this be a real consultation section, an exchange of ideas, among those who have, and those who have not, solved some of the problems of structural concrete. Questions and Discussions are cordially invited.

281. Tanks for Vegetable Oil

"We have in mind building a tank about 48 ft. long, 7 ft. wide, and 6 ft. deep for the purpose of holding linseed oil, and are very desirous of getting all of the information that we can concerning the advisability of using concrete for this purpose. The tank will contain about 200 gals. and will have a division wall across the middle.

"The tank will be exposed about 3 ft. out of the ground. It is our intention to give this two coats of cement paint and one coat of enamel on the inside. If you can give us any information concerning this, we would appreciate it."

281. Editorial Discussion

Under the auspices of the Assn. of Amer. Port. Cem. Manfrs., extensive experiments have been conducted to determine the action of concrete in contact with various materials. A recent report presents a summary of the tests made to determine the action of linseed oil on concrete. The tank used in the test was built of 1:2:4 concrete, a wet mix, and using trap rock. In the first series of tests there was no special treatment of the concrete. The report states that the tanks were uninjured, and the container has no effect on the oil at all. A small amount of lime is reported present in the oil and the acid value of the oil is lowered, improving the quality. The report recommends concrete as safe storage for oil.

Additional experiments were made upon tanks surfaced with special materials, and tanks made of concrete in which special materials had been incorporated or mixed with the concrete. The facings were as follows: neat cement paste; neat cement paste containing 15% residual oil; neat cement paste containing 15% residual oil and 7% barytes.

The special materials mixed with the concrete were as follows: 15% residual oil; 15% residual oil and 7% of barytes.

The report states that in no case was a specially treated tank found to be better than one built of plain concrete.

282. Concrete Tanks for Sauerkraut

"We are to build a concrete stave tank, to be used in curing sauerkraut. Can such tanks be made proof against the salt water and acids in the kraut?"

282. Editorial Discussion

Concrete tanks should furnish ideal containers for the storage of food stuffs, and for this purpose they are coming into more and more general use. Tests conducted under the auspices of the Assn. of Amer. Port. Cem. Manfrs., have been conducted to develop data along these lines and one series of tests was made specifically to determine the value of concrete tanks for the storage of sauerkraut. The standard concrete tank used in the entire series of tests was made of 1:2:4 concrete, mixed wet, with trap rock as aggregate. In the first series of tests there was no special treatment of the concrete and the report states that the concrete had no effect on the sauerkraut, and the sauerkraut had apparently no effect on the concrete. The report further recommends that it is safe to store kraut in properly prepared tanks and that plain concrete is as good as concrete specially treated, or even better.

Experiments similar to others in this series of tests to determine the value of different treatment of the concrete were carried out. Different materials were mixed integrally with the concrete itself, and used as a surface facing. The facings used were as follows: neat cement paste; neat cement paste containing 15% residual oil; neat cement paste containing 15% residual oil and 7% barytes. The material mixed integrally with the concrete is as follows: 15% residual oil, 15% residual oil and 7% barytes. The report states that the plain concrete tanks were as good in every respect as those specially treated.

* * *

286. Concrete Floors in Soap Factories

"Do the fats and alkalies used in manufacturing soap have any effect on concrete wearing surfaces?"

286. Editorial Discussion

Caustic soda solution is a material used in soap manufacture and a recent report made to the Assn. of Amer. Port. Cem. Manfrs. covers in detail an investigation made to determine the effect of caustic soda solution stored in concrete tanks. The tank used was made of 1:2:4 concrete mixed wet, and using trap rock as aggregate. There was no special treatment of the concrete. In these tanks a 4% solution of caustic alkali was stored. This had no effect on the concrete and the contents are reported to be uninjured, although sodium carbonate formed to some extent. This same reaction would have taken place in any open container.

The report recommends that it is safe to store a 4% caustic soda solution in a properly prepared concrete tank.

To determine the value of special materials in this construction, additional experiments were made upon tanks proofed with admixtures to the concrete of residual oil and barytes, used both integrally and as a surface facing. The facings used were two coats "Bakelite[1] No. 15" baked, neat cement paste; neat cement paste containing 15% residual oil; neat cement paste containing 15% residual oil and 7% barytes.

The materials mixed integrally with the concrete were 15% residual oil and 7% barytes. The report states that in no case was a specially treated tank found to be better than one built of plain concrete.

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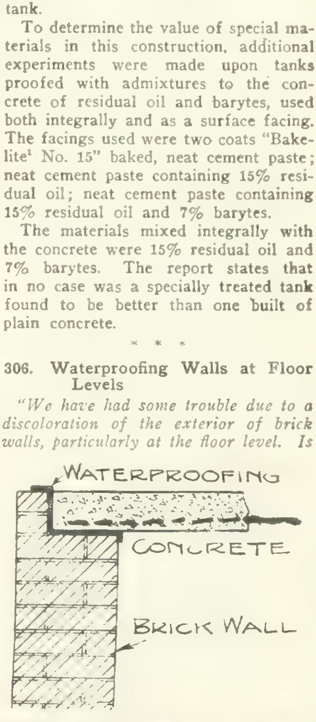
306. Waterproofing Walls at Floor Levels

"We have had some trouble due to a discoloration of the exterior of brick walls, particularly at the floor level. Is



Waterproofing a Floor-Seat in a Masonry Wall

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[1] Bakelite Co., Yonkers, N. Y.

this due to the lime in the concrete floor? Would the method as suggested in the accompanying detail help? We are planning to use hot tar as a waterproofing material."

306. Discussion by Charles S. Whan*

As a solution to the above question I would suggest the following methods: Where the concrete comes into contact with the walls, either as a facing for the walls or as a floor seat, a good method to follow is to plaster the seat about ½-in. thick with a 1:1 mortar, using a standard non-staining white cement and clean sand. This should be done the day before the concrete is placed. Where extra precautions are to be taken the plaster surface should be coated with an impervious thick waterproofing of some kind. It is safer to do this where a porous face brick or a limestone might come into contact with the concrete.

I would not recommend using a hot tar as a waterproofing material unless it is carefully mopped on two or three times so as to fill the blow-holes which might be caused from dampness. The discoloration on the inside of the walls is due to the lime in the cement when a too wet concrete is used.

* * *

311. Fastening Machinery to Concrete Ceilings

"Our problem is to take care of the shafting and various machinery in a small machine shop. Instead of trying to work out beforehand the positions of all the overhead machinery, motors, jack shafting, etc., we thought it might be possible when we run the floor to put in some of these lower cost insert anchors, say 4' on centers each way, or even 2' on centers each way. By bolting 2 x 4's or 4 x 4's to these at any point we could place the machinery anywhere we want to or change it at will. Is this done at all and what further advice can you give us?

311. Discussion: By R. Morley†

The use of inserts and expansion bolts has now largely taken the place of the old wood-screw and the nail, which are daily falling into disuse. This, of course, is due to the progress being made in modern building construction, where brick, concrete and quarry stone are being used extensively, due to fire laws and to the fact that various kinds of material, interior finish, machinery, etc., have to be fastened to the masonry by some substantial method. Examples of these are machinery of all description, electrical apparatus and iron work to the ceilings, side walls and floors; also railroad appliances, such as signals, etc.

Inserts: The actual field of the insert is limited to construction of new concrete buildings. Its function is to furnish a tapped hole at a certain specific point for fastening any device in final position. Because of this, it is necessary that the contractor, in putting up the forms for the concrete, accurately determine the intended location of the insert and fasten it to the wooden form at exactly the right point, before the concrete is poured. This is true whether the insert is to be placed on the ceiling, floor or wall. If one considers in detail, here, the cost of the labor in marking the location of the insert, and the cost of the insert, and the minimum amount of labor required to fasten it to the wooden forms, there appear three different costs.

To bring out one of the several reasons why the insert will be found to be faulty after the concrete has been poured and the form is knocked away, it is well to call attention to the fact that the lumber used in making the form is seldom, if ever, seasoned, nor can the material be of selected quality, as the first cost would be prohibitive. Good weather may precede the pouring of the concrete, but stormy weather may set in; if the latter, the forms become water-soaked and more or less warping and twisting takes place, which means that the insert which has been fastened upon these forms is thrown out of alignment or square, while in many cases the warping of the timber itself loosens the insert. When the men start to pour concrete, the insert is likely to be thrown out of alignment and the necessary tamping of the mass which follows, further loosens and shifts the insert, so that when the forms are knocked away, it has either shifted its position materially or has been lost entirely, or is so out of square with the surface of the concrete as to make a first-class job impossible. This means material as well as labor loss and the work has to be done all over again in many cases.

Thus we see that the field of the insert is limited, especially in the construction of lofts or buildings in general, for the reason that it is impossible, at the time of designing the building and laying out the concrete forms, to locate exactly the position of the various materials to be supported by the inserts. This is in a measure possible with sprinkler systems, ventilating or heating appliances, but is even difficult with these, and impossible with many other attachments to be hung to concrete walls and ceilings.

Experience shows that in contracting for the installation of material and being compelled to work to the inserts as installed, the cost of labor is usually twice that of the cost of resorting to the use of expansion bolts.

In loft buildings, where tenants are manufacturers in various industries, where machinery and electrical equipment are to be anchored to both floor and ceiling or on the side walls, the insert becomes immediately utterly impracticable.

It is particularly so when a group of bolts are necessary for anchoring some piece of machinery in definite position relative to its neighbors, such as in bolting a motor to the floor or ceiling, where there is an exact relative position necessary between the bolts themselves, and where the location of the complete set is necessarily confined to a definite position where alignment with shafting is necessary. The same annoyance has to be contended with even in drilling for expansion bolts if the drilling is not accurately done.

Now, comparing item for item, as far as labor and material are concerned to show the advantages of a good expansion bolt over those of the insert, we note the following:

For the insert it is necessary to mark on the centering the location of the bolt, with more or less indifferent success as to the result. With expansion bolts it is necessary to locate the position of the drilled holes, but this can be done with a rigid template, and position of the holes definitely located on the concrete wall or floor.

The average cost of the insert, as compared with that of an expansion unit, is somewhat greater, making expansion anchorage the cheaper of the two as to material.

As against the cost of fastening the insert to the wooden form and indefinite success as to results, we have the cost of electric drilling of the actual holes for the expansion bolt. We accomplish this by an electric hammer system which can be contracted for where quantities are sufficient. The drilling is, we have found, cheaper than fastening inserts on the forms.

A large percentage of inserts are lost when pouring, and those that are not lost or dislodged are thrown out of alignment, necessitating additional cost in bringing them straight. There is no loss on expansion bolts up to this point or afterwards in making the insertion into the drilled hole.

All things considered, when the insert is used as an expansion bolt after the building has been erected, the expense of drilling and inserting and waiting for the concrete to set makes it a very much slower and more expensive operation, whereas the use of expansion bolts is rigid and positive, and furnishes a tapped hole for a machine bolt and not the tapped hole for a lag screw.

Where an insert may be desired on the finished job, as against an expansion bolt, it is necessary to have cement and sand after drilling and installing it, in order that the cement may be made to flow into and about the hole to hold the insert in position. It is then necessary to wait some 12 hrs. to 24 hrs. for proper setting before the insert can be used to support its load. An expansion bolt, on the other hand, takes but two or three minutes (according to the size of unit used), after the hole is drilled, when the system can be installed and machinery hung upon the system and removed as frequently as desired.

For example, one min. would be required to drill a hole by an electric hammer drill for a ⅝-in. expansion bolt, to proper diameter and depth, the hole being 1⅛" in diameter x 2" deep. If a greater depth of hole is required, so that the anchorage can be placed back from the face of the wall, we will say it takes two minutes to drill. This class of work is usually done by a man at the rate of $2.50 per day, and on the average the man's time and depreciation on tools would amount to about 1¾ cts. per hr.

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*Concrete Contractor, Hoboken, N. J.

†Gen. Mgr. Cinch Expansion Bolt Co., N. Y. C.

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312. Flood Area of Concrete Bridges

"It has recently been brought to our attention that open spandrel bridges are to be recommended for any district subject to floods in that they afford a greater flood area by allowing the water to flow through the open spandrels. Is this of sufficient importance to advance further the use of open spandrel work on the smaller country bridges?"

312. Discussion by A. M. Felgate*

Regarding the use of open spandrel design in concrete arches, I would state that the open spandrels are preferred when the span and rise are of sufficient size to permit their use.

In designing a concrete arch for any given location, the span should be as large as possible in order to carry off the early rise of water, as the ice is generally carried out before the maximum height of the flood is reached.

On small bridges, up to 70-ft. span, and when the distance from the road way to the water is less than 20', open spandrels are not advisable. In these cases a solid barrel arch with a spandrel fill is the better practice. Over ravines, with rock sides, very light concrete ribs with spandrel posts and a slab floor can be used.

When an entire river valley is under water, which covers the bridge entirely, the design of the spandrels has little effect. In such cases only a high-level viaduct can carry the flood. The financial resources of the community will then be the limiting factor governing the size of the bridge and the problem would resolve itself into getting the maximum amount of waterway with the funds available.

* * *

313. Comparative Efficiency of Monolithic Conduit and Large Concrete Pipe

"We are planning to build ¾ mile of concrete drain pipe 24" in diameter. The ditch will be from 4' to 8' in depth. Our present plan is to construct a wooden form 24" in the clear with either flat or rounding bottom, and without top. We would build this form long enough for ½ day's run. When the concrete is sufficiently set we would move this form forward for another pouring. When the concrete is set we shall place thin boards over the top with about 1" lap on each wall, and cover this with 3½" to 4" of concrete, with a light reinforcing. Could this be placed cheaper than a 24-in. tile?"

313. Discussion by Charles E. Sims†

In regard to the comparative efficiency and economy of large concrete tile or a poured-in-place conduit, it may be stated broadly that tile would be cheaper since less concrete would probably be used and all the work required would be done at a point where the assembling of materials and manufacture of the tile would be most convenient and economical. The local conditions vary so much that a broad statement is probably of little service. There may be little prospect for the same class of work at the town where the work is located, or shipping tile may be limited to a small territory, in which event the establishment of a factory would be the wrong way to go at it.

It is possible to make the 24-in. tile close to the ditch by tamping or pouring the concrete into hand molds and there is no doubt that this would be a cheaper method as compared to the conduit poured in the trench. It would have the advantage of greater speed and greater opportunity for inspection. The disadvantages would come in having to protect the new tile from freezing or from direct sun and wind which injure the concrete. If 24-in. tile is tamped by hand and the mold is stripped from the tile at once, a damp concrete, not wet, must be used and uniform density will depend upon the individual doing the tamping. A man who has acquired the knack of it can make from 60' to 70' of 24-in. tile, (material mixed for him) in a 10-hr. day. The material cost can be figured.

As to the comparative efficiency: the shape may be made the same for either the tile or the poured conduit if desired, hence one system is no better than the other in respect to shape. The tile might not be as suitable as the poured conduit unless made with bells so as to seal the joints, or there are patented methods of bedding irons in the tile walls which lock the tile end to end and they can thus be cemented together.

It would be difficult to draw a line between the latter method and the poured conduit as to efficiency. In a poured conduit, would it not be advisable to make it in one operation instead of having the invert and the sides separate from the cover? There are on the market collopsible metal forms for this purpose. Not knowing what the conduit is to be used for and in the absence of details as to local conditions, the above answers the questions as best I can.

* * *

314. Concrete Finish to Resemble Tiling

"Some weeks ago in the East I visited a country club, the porches of which were made of concrete, marked off in squares of about 10 in. with a rather deep groove tooled in, into which had been poured a black cement filler. This gave the effect of tiles.

We are building a country club here and I want to use the same kind of a porch floor, but the men in the contracting business locally do not seem to know anything about any cement that would give a smooth tile-like finish that would not 'dust.'

"I find many references to various composition floors, but this that I saw was concrete, pure and simple, laid right on the earth, about 4 ins. to 6 ins. thick, reinforced and finished on top in the usual way. The texture of surface was like cement yet not as gritty as is usually found, rather a finer sand must have been employed, I fancy."

314. Discussion by C. F. Mullen*

The porch floor which is described is simply a cement finished floor, jointed to resemble tile, with the joints filled with colored mortar. We have done more or less of this work for a number of years back. The smooth tile-like finish is obtained by the use of plenty of neat cement, or "shake" as the cement finishers term it, and this is troweled to a hard, smooth finish. If the joints are not to be filled, the ordinary jointer should be used, but if the joints are to be filled with mortar, we suggest that a square-edge jointer be used instead of the ordinary one. The joints made in this way are filled with mortar colored as desired.

The floor itself when jointed in this way is very often colored dark red to correspond with the color of a quarry tile floor.

Referring to the matter of the floor "dusting," a floor laid in this way with the proper workmanship will not dust.

* * *

315. Protection of Corners of Interior Columns

"We are writing to ask if in designing large garages and structures used similarly, it has been found necessary to specify any protection for the corners of the concrete columns? We have wondered if it would not be a good idea to use a curb bar for the four corners of the column carried 3' or 4' above the floor. Do you know of any such use?"

315. Discussion by Emile G. Perrot†

We do not approve of square columns in garages. The best solution of this problem is not to have any corners, but to make the columns round. We have done this in all the garages which we have designed and it is not only a protection for the columns, but also for the automobiles.

We place around the base of each column a cast-iron fender, similar to fenders that are put on entrance doorways to stables. This is also a necessity.

315. Discussion by Chester S. Allen‡

Relative to the question of specifying any protection for the corners of concrete columns in garages, we would state that we always protect square columns with four angles, and round columns with a sheet steel casing.

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*Bridge Engr., Cuyahoga Co., O. (Cleveland)

†Mgr. Worthington Concrete Tile Co., Worthington, Minn.

*Masters & Mullen Construction Co., Cleveland

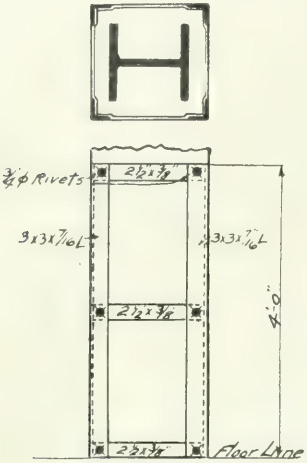
†Ballinger & Perrot, Archs. and Engrs., Philadelphia

‡Lockwood, Greene & Co., Boston

In one or two instances we have used a curb bar, but it has not worked out as satisfactorily as the angles. As a general proposition, we run these angle protections 4′ above the floor.

315. Discussion by Wilbur J. Watson*

We always protect columns when subjected to possible injury from trucks and wagons. The accompanying sketch shows a design which was used on the building for the Griess-Pfleger Tanning Co., Chicago, and we consider this a good detail. The guard as shown consists essentially of 4 angles, 3″x3″x7/16″ and 4′ high, fabricated into a frame by steel strips 2½″x⅜″, at three points. Around this frame the column centering is built. So far this has worked out well.



Detail of Column Angle Guard for Interior Columns

315. Discussion by C. M. Leonard†

Square columns in garages or warehouses should always have angle guards in the corners. We use round columns rather than square columns whenever possible. For round columns a very satisfactory guard is made of No. 12 galvanized iron completely enclosing the column for 4′ above the floor. These guards are ordinarily made in three sections as shown in the sketch and the edges are turned in 1″ and bolted with ¼-in. stove bolts about 7 ins. on centers. Used in this manner, the guards act as forms for casting the lower part of the column.

Plan Detail Showing Arrangement of Sheet Steel Guard for Circular Columns

* * *

316. Cost of Concrete Sidewalk

"What will it cost to lay a walk 108 long, 26″ wide, with a 5-in. cinder fill, 5″ of concrete and a 2-in. top dressing or wearing surface? Mix 1:2:4 concrete, top dressing 1:3.

"Cement costs $1.95 per bbl., cinders about 50c per load of 1 cu. yd., sand $1.75 per ton, stone $1.75 per ton. Labor —finishers 35c, helpers 22½c per hour.

"What quantity of each of the materials—sand, stone, cinders and cement —will be required? How many sq. yds. is one man supposed to lay under ordinary conditions in one day of 8 hrs?

"In the above questions it is assumed that the excavation is to be completed and not to be figured in the cost. Could I have as much detail as possible explaining how the amount of each ingredient is arrived at?"

316. Discussion by D. D. Schouler*

We would estimate the cost of the sidewalk specified in the above at $44.50 for 234 sq. ft. of walk. Below are given amounts for this work: Concrete 1:2:4, and 2-in. top 1:3.

Cement	10	bbls.	at	$1.95	$19.50	
Stone	4	cu. yds.	at	2.63	10.50	(3000 lbs.=1 cu. yd.)
Sand	3½	"	at	2.10	7.35	(2500 lbs.=1 cu. yd.)
Cinders	4	"	at	.50	2.00	
Finisher, 7 hrs.			at	.35	2.45	
Laborers (2) 6 hrs. each			at	.225	2.70	
					$44.50	

Each man should do 100 sq. ft. per day of 8 hrs. under favorable conditions. This walk will cost about 19 cts. per sq. ft.

Assuming that the voids in stone are filled with the sand and those in sand by cement, the concrete when properly mixed will take up about the same space as the stone (dry). The top coat will require about 1½ cu. yds. of sand and about 13 bags of cement. By the elimination of the cinder fill (unless unfavorable conditions prevail) and making a mixture of 1:2½:5½ with a 1″ top coat the cost may be kept down materially. The walk could be made 4 in. over all.

316. Discussion by Percy H. Wilson†

The following table presents in detail the estimated quantities of materials required for this work, together with an estimated cost of the entire job. We would recommend too, the various bulletins of this Association, which would be of interest in this connection.

Estimating Sidewalk Work

Quantities Required (for 100 sq. ft. of walk)
Cement (measured loose) 4.4 cu. ft. to bbl.
Voids in stone, 45%
Voids in sand, 40%

For Concrete, mixed 1:2:4, 5″ thick
Cement 2.02 bbls.
Sand 0.65 cu. yds.
Stone 1.30 cu. yds.

For Top Finish, mixed 1:3, 2″ thick
Cement 1.17 bbls.
Sand 0.63 cu. yds.

Total Quantities: Area of pavement=108′x 2.17′=234.4 sq. ft., say 235 sq. ft.
Cement 2.35 (2.02+117)=7.5 bbls.
Sand 2.35 (0.65+0.63)=3.01 cu. yds.=4.06 tons.
Stone 2.35 (1.3)=3.06 cu. yds.=4.13 tons
Sand and broken stone weighing approx. 2700# per cu. yd.
Cinder fill $\frac{.42 \times 235}{27}$=3.65 cu. yds.

Estimated Cost: Based on 1 mason and 2 helpers laying the pavement in 1 day. (One man lays approx. 150 sq. ft. per day of 8 hrs.)

Cement	7.50×$1.95=	$14.62
Sand	4.06× 1.75=	7.11
Stone	4.13× 1.75=	7.22
Cinders	3.65× .05=	1.83
Labor	1 @ 2.80=	2.80
	2 @ 1.80=	3.60
		$37.18

Cost per sq. ft. $\frac{\$37.18}{235}$=15.8 cts. (omitting contractor's profit).

* * *

317. Preserving Wood in Concrete

"Several years ago the writer was in charge of concrete construction; the walls were poured concrete and the window frames, of course, were set in. It is field practice in this sort of work to fit a strip along the window frame to tie it into the walls, and it occurs to me that it might be an additional precaution if specifications required that the window frames be coated with some adhesive, preservative waterproofing. This would serve two purposes; it would not only keep water out of the wood and preserve it, but it would also help to make a tighter bond between the window frame and the concrete. Is this a practical suggestion?"

317. Discussion by Chas. Freund*

The writer together with several other engineers sometime ago examined some concrete work that had been up several years. These inspections were prompted by our desire to endeavor to improve on the ordinary and cheaper method of concrete construction, and one of the most important points taken up was the question of securing watertight joints between the woodwork, such as window frames and door frames, and the concrete.

At the present time it is the usual practice simply to fit a strip along the back of the frame to tie it into the wall, and it occurred to us at the time, that as your correspondent suggests, it would be an additional precaution if the portion of the window frames and other woodwork which is to set against the concrete were to be coated with a waterproofing.

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*Consult. Engr., Cleveland

†Pres. Leonard Construction Co., (not Inc.) Chicago

*Secy. Schouler Cement Const. Co., Newark, N. J.

†Sec. Assn. of Am. Port. Cem. Manfrs., Philadelphia

*Mem. Am. Soc. Eng. Contr. Sec. The Wemlinger Co. Inc., N. Y. C.

After a thorough discussion, we were satisfied that this would be a big advantage in concrete construction as it would serve two purposes. It would make a tight joint, thereby keeping out the water, and would preserve the woodwork.

At a later period we put this method into actual practice on one or two occasions, and we are prepared to say that the results up to the present time are perfectly satisfactory. The material used was a heavy, refined asphaltum paint.

* * *

318. Concrete in Alkali Soils

"What has been the experience of users of concrete pipe and tile in alkali soils? How are concrete tile to be made to resist the disintegrating effects of alkaline solutions?"

318. Editorial Discussion

In this connection, possibly to have an effect of bringing to these columns a fuller discussion and a freer expression of opinion based upon satisfactory and unsatisfactory experiences and suggestions for meeting various conditions, we reprint here an article, "The Action of Alkali on Cement Pipe Lines," by Will L. Brown, consulting engineer, San Bernardino (Cal.) Water Co., published recently in the *Southwest Contractor and Manufacturer*, as follows:

It may be of interest to some of our water companies and individuals and also to some of our contractors in this land of irrigation, to know some of the effects of alkaline water on concrete pipe. A knowledge of when not to use any material is far more just to that material than to condemn it entirely because it has failed in some instance when it should never have been used at all.

My attention was called some time since to a cement pipe line in the upper San Bernardino Valley adjoining this city that had become "rotten" and failed. In company with two other engineers, I made an examination of the line in question and was much surprised at what we found.

The pipe was about 1,000 ft. long, 10" inside diameter, and made and laid under contract as a drain from a pump-pit situated in a low, wet tract of land. The ground water in this tract was from 3 ft. to 5 ft. below the surface in summer and in winter water stands in all depressions. The soil itself is a close-grained fine sand, and clay, quite heavily charged with those mineral salts commonly termed "alkali."

The "alkali" from this particular locality has never been analyzed so far as I have been able to learn, but is probably of the same composition as other white alkalies of southern California, viz., the sulphates of calcium and magnesium, together with smaller quantities of sodium chloride, nitrate, carbonate and generally some bicarbonate. Altogether this makes a very caustic, active solution, especially that portion at or near the surface, where for many seasons the waters working up from below have brought the salts with them, and then evaporating during the succeeding dry summers have left excessive quantities of the solids, as a white incrustation of efflorescence.

The pipe was a good average cement pipe, made under a 1:4 specification, and although no especial pains were taken either in mixing the aggregate or in the tamping and curing, it would pass inspection without any serious objection. It was washed inside with a neat cement wash to lessen its porosity. The line was laid from 4 ft. to 8 ft. deep, with considerable difficulty, because of water and caving trench. Some of the joints were made with plaster of paris, but the jointing was seldom water tight.

The third year after laying, depressions appeared over the line and in the fourth year several large pits formed—some of them 8' across and of various lengths. In several instances when the surface dropped, tunnels were observed, extending along the line. This sinking was caused by ground water washing the earth away wherever a pipe failed. In the fifth year the line was entirely useless, and a new line of vitrified clay pipe was constructed.

An examination of many fragments of pipe taken from the line showed the cement to have almost entirely disappeared from the outer portions of the pipe wall. The sand could be readily crumbled with the fingers, it often being nothing more than a sandy mud. What cement-like material still remained had no life or strength at all.

The inner part of the pipe wall where the cement wash had penetrated about 3/8 in. was less affected and retained its form, though possessing very little strength. These fragments when allowed to dry in air crumbled and often fell apart.

This disintegration of cement in the presence of alkaline solutions has been very carefully investigated by the chemical department of the Montana Agricultural Experiment station and also by the Colorado Agricultural College. The results of these independent investigations show a remarkably close agreement, and with a number of similar failures that have come under the writer's observation, indicate that the use of cement pipe in many locations is very likely to be a misuse of this very economical material.

The chemical reactions taking place when the alkaline ground waters come in contact with the cement, are very complex. The liberation of calcium hydroxide during the process of setting, and later hardening of the cement means that a compound is formed which even distilled water will dissolve and carry away. When we have this reaction and solution taking place in the presence of strong alkaline solutions and under several pounds' pressure, the effect is much accelerated. M. W. P. Headden, chemist of the Montana Experiment Station, mentions a sample of cement tiling reduced to a putty-like mass mixed with sand after being laid only eight or nine months.

These reactions are continuous; soluble compounds are formed and carried away by the percolating waters, thus constantly exposing new surfaces, and it is only a question of time when the pipe falls. This effect is readily seen in concrete-lined ditches carrying a constant stream and even in irrigation pipe with only an intermittent flow.

All the ground waters of the Southwestern United States carry a considerable content of these alkali compounds, especially magnesium and calcium sulphates. All sulphates are active in their action on cement, and magnesium sulphate is the most active of all. The water coming from our granite mountains contains this salt in very large proportion. Its action on cement can be clearly observed in every concrete-lined conduit, even the stones laid in cement mortar and lining many ditches, can often be lifted out or will drop, after two or three years of contact with the running stream.

Most interesting and complete discussions of this subject are given in Bulletin No. 132 of the Colorado Agricultural College, and in Bulletins 69 and 81 of the Montana Agricultural Experiment Station.

Quoting from Circular No. 8, issued by the Montana Experiment Station: "We recognize this as a cement age, but this fact does not warrant its use in important structures by people who have not given it some special study. With our present knowledge we could not advise the use of cement pipes for drains or sewers where they are to be laid in alkaline ground. When prepared by the ordinary methods we believe that concrete should not be used where solutions of alkali will come in contact with it. In such pipes or drains the pressure of the ground water tends to force the alkali through the concrete and hasten the disintegrating action."

Here in Southern California where hundreds of thousands of dollars in crop values depend on irrigation, the users of this kind of pipe should investigate the matter for each location or system, as the failure of a pipe line at a critical moment in our dry summer might mean the loss of many times the cost of a more durable material.

318. Discussion by Llewellyn T. Bachman*

Referring to the article by Will L. Brown, C. E.: That alkali affects concrete is not disputed by engineers who have examined the subject, but a great difference of opinion exists regarding the extent of the action. Irrigation engineers who have found the action of alkali to have been particularly severe on the Sun River project in Montana, near Great Falls, and also on the Shoshome project in northern Wyoming, have investigated the subject carefully and continue to use concrete, although of a denser quality than before the alkali troubles were diagnosed. In Iowa, where the subject is receiving very careful attention, the opinion is growing that a hard, dense surface resists alkaline action on concrete drain tile far more than ordinary concrete. The subject is a very complex one and requires years of investigation to prove anything decidedly conclusive, but it is known that waters containing magnesia must be avoided in making cement mortars for concrete pipe, in that a hydrate of lime is formed by the action of the water on the cement and in turn precipitates the magnesia from the water used, all of which forms a part of the mortar and the hydraulic value is disturbed by the parting plane.

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*Chemist, Santa Cruz Portland Cement Co., San Francisco

The same may be true in the use of waters containing sulphates which readily form double salts. That is, a simple sulphate will substitute a portion of its magnesia of soda for lime, iron or alumina, thus removing some constituent of the cement and substituting in its place a soluble alkali. The effect may be similar when cement concrete becomes a depository of sulphates from infiltrating waters which are evaporated in any way from the concrete so as to leave the salts behind. The percentage of sulphate would increase until it would finally destroy the concrete.

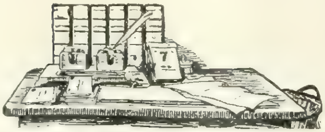
To avoid this result in soils that contain such waters, one way is to provide a natural drainage which will cut off the water from permeating the concrete; and another to prepare the concrete so as to render it impervious to water. We know of cisterns which serve as reservoirs for alkali waters to have resisted the alkali action for 10 years and today are apparently in as good a condition as ever.

From all we know it would appear that concretes made under similar specifications are not adapted to all classes of work. It is known that the heavy foundation specifications would not meet the requirements of a sidewalk surface; and therefore one may learn that the imperviousness in concrete will be the solution for that class of concrete work used as drain tiles in alkali districts.

Construction Work in British Columbia

Consul Abraham E. Smith, stationed at Victoria, B. C., reports in a recent issue of the *Daily Trade and Consular Reports* that building operations in British Columbia will increase as much in 1913 as in 1912. Construction has started on the Tolmie school, costing $90,000; new jail, for which $350,000 has already been appropriated; new $75,000 Dominion theater, $75,000 roundhouse and machine shop of Esquimault & Nanaimo Ry., $75,000 Kinemacolor theater for Inland Amusement Co., $60,000 addition to Dominion Hotel, Dr. T. J. Jones's $35,000 apartment building and the $75,000 Elliott office building, while several fine buildings are going up on Rockland Ave., including a $25,000 one for R. Nation and a $10,000 one for Charles Williams.

Permits and buildings for Victoria for March aggregated $643,075. The total for the first quarter of this year was $2,852,723. The Hudson Bay Co. has authorized a $250,000 department store, to be modeled after the stores at Vancouver and Winnipeg. The contract has been let for the $400,000 Johnson St. Bridge; work will begin this fall and require about two years to finish. Victoria's breakwater will probably cost $10,000,000, which will give the port a magnificent wharf.



CORRESPONDENCE

Through Fire and Flood in Ohio

[The following letters have come in from Concrete-Cement Age readers in Southern Ohio, and bring first hand information on the way in which concrete structures withstood the destructive attack of flood and fire.—Editors.]

In every case and under every existing condition, as far as fire, water, and settlement of buildings are concerned, concrete structures withstood the tests in every respect. We have made a number of examinations of partially finished concrete buildings and in every respect found them intact.

As far as the bridge situation is concerned, the only bridges that we have standing are the reinforced concrete structures. In several instances these bridges were entirely submerged, with tons of wreckage standing against them, and upon examination we found no material damage whatever, except to rail decorations, etc., which were smashed by the wreckage. The paving over these bridges was in excellent condition.

F. J. Hughes.

F. J. Hughes & Co.
Dayton, O.

Concrete Structures Suffer No Damage

Concrete structures suffered no damage whatever in the recent flood. Only a few feet of railing were washed away on a concrete bridge, but nothing suffered seriously. A few country bridges (small ones) were undermined and settled somewhat. In all there was very little damage to concrete structures. Sidewalk pavements were undermined and are overhanging. Concrete behaved very well all over the territory.

G. R. Stattelmann.

Dayton, O.

All Concrete Structures Standing

In this county, very little damage, comparatively, was done by the flood, as this is a section of rugged topography. The county lost three highway bridges. In two cases the structures were swept off the abutments and in the other case an abutment was overturned, due entirely to an insufficient foundation.

In this city, the bluff rises so rapidly from the river to the plateau on which most of the city rests, that only about half a block in width along the river was flooded. All our large mills had to close, but that was due to back-water, without appreciable current, and there was no destruction of structures.

Just below town a masonry retaining wall went out, but it was wretchedly built, and failed from undermining. I understand that the small concrete bridges and the culverts are intact.

In this section, there has been no very extraordinarily severe test of structures * * * * I have built nearly a million dollars worth of concrete in this county; it is all standing.

T. H. Loomis.

Civ. and Contracting Eng.
Steubenville, O.

The "Y" Bridge at Zanesville Withstands the Flood

Two bridges only have withstood the flood. The new Fifth St. bridge, of steel enclosed in concrete with a reinforced concrete roadway was not damaged, save slightly, and that by drift knocking over some of the iron pipe side railing. This damage can be repaired at little cost. The pavement was brick on sand cushion, except over the channel span, where creosote blocks were used.

The other bridge standing is the renowned "Y" bridge, which was built in 1901 on the site of the old "Y" bridge at the foot of Main St., connecting Zanesville proper with West Zanesville by the right wing and the old seventh ward by the left wing. These two bridges alone, each of concrete construction, remain open to traffic from east to west, in the entire Muskingum valley. The property loss has been conservatively estimated at over eight million dollars in Muskingum county alone.

There have been certain pessimistic people in this city who, for the last couple of years, have been wanting the good, old "Y" condemned as unsafe for traffic. For all that, it weathered a flood which hid it completely from view for more than 48 hrs., and had every one guessing as to its ultimate fate. In less than four days after the water had receded, the old concrete monument was open to wagon traffic, and it was doing its duty faithfully.

There surely was an immense amount of energy wasted in pounding the old concrete structure. All kinds of buildings were seen floating down stream. A refrigerator car loaded with cabbage was carried down by the flood for over three miles and deposited on one of the noted garden farms of the Muskingum valley.

While many of the brick structures were either totally destroyed or considerably damaged, reinforced concrete seems to have weathered the flood with no material injury. The only material damage done to the "Y" bridge was that the concrete coping was broken down somewhat by the battering effects of the flood. While the flood was at its crest, the water was pouring completely over the bridge.

The accompanying illustrations show the "Y" bridge when the waters were at the highest, or nearly so.

The trolley and light poles can be seen in the foreground, and the single remaining B. & O. span and the flour mills just beyond, and the reinforced viaduct of the 5th St. bridge in the dis-

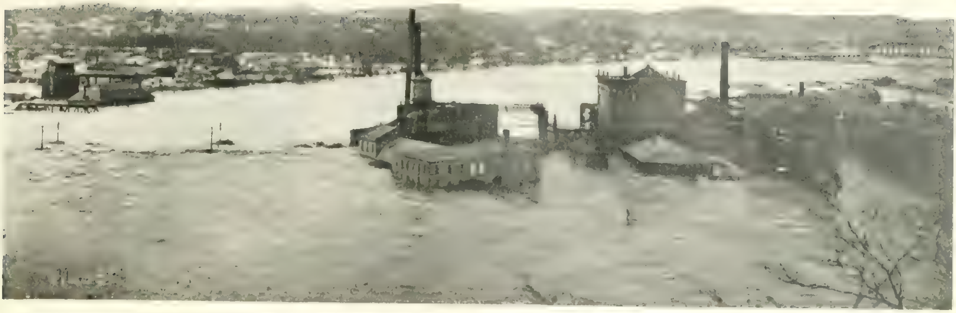


Fig. 1—The "Y" Bridge at Zanesville Under the High Flood

The Trolley Poles and the Riffle in the Flood Surface Indicate the Position of the Bridge

tance at the right. The electric light plant was so much damaged that we had no light from it for more than two weeks. Fig. 1, shows a view taken from Putnam hill. Fig. 3 shows the "Y" bridge under traffic after the flood had receded and shows the B. & O. trestle which was placed in *eight days.* The wrecked girders can be seen in the water under the spans of the "Y" bridge, at the right of the view. By close observation the broken coping of the concrete bridge can be seen and in the distance the wrecked levee along the west bank of the Muskingum. The flour mill at the right in Fig. 1, and in the center of Fig. 2 shows the relation between the two illustrations.

R. H. Lewis.

Zanesville, O.

* * *

Are College Theses Worth While?

Friends, students and older practicing engineers have often asked me, "Are Theses Worth While?" and as my answer has usually been in the negative, perhaps Concrete-Cement Age readers would be interested in the reasons for such an answer. I realize that much may be said on the subject, and perhaps these ideas are in error, but my observation has been that often a thesis is more for the benefit of the instructor than for the student, and quite often it does not seem to be of value to either of them.

The fact that the thesis assignment is made to several students at the same time, to a large extent takes out the personal element. Of course, it may be necessary because certain men will not, or cannot, decide on a subject, or because in the judgment of the instructor the work required in computation or laboratory experiment will be more than one man can properly perform or digest. In case two or more men do work together, one will really do all the work, and the other will give advice and find fault. One student in a class will be brighter and better prepared than the other, yet to him will fall the easy part of the work, while some dull class-mate is spending hours he should be out of doors, trying to understand the work sufficiently to write about it. At a certain mining school two students wrote a thesis on "The Design of a Cyaniding Mill." One made all the chemical analysis of the ore, read all the available works relating to this type of mill, decided on the process and conclusion and designed the mill. The other student made a few tracings, and perhaps has not even read over his copy of the work as presented to the faculty. In engineering schools the result is that the instructor must point out the questions to be solved—may even want some item cleared up as the basis for a magazine

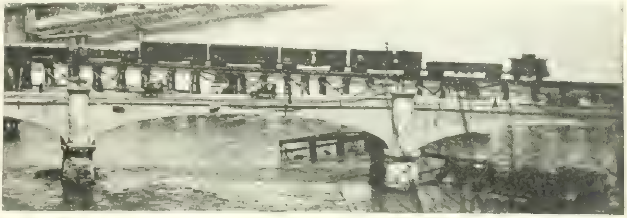


Fig. 3—A Detail View Showing the Broken Coping on the Zanesville "Y" Bridge and the Wrecked Spans of the Steel Railway Bridge

The railway bridge shown is an emergency timber pile trestle. The channel span of the railway bridge, as shown in Fig. 1, withstood the flood

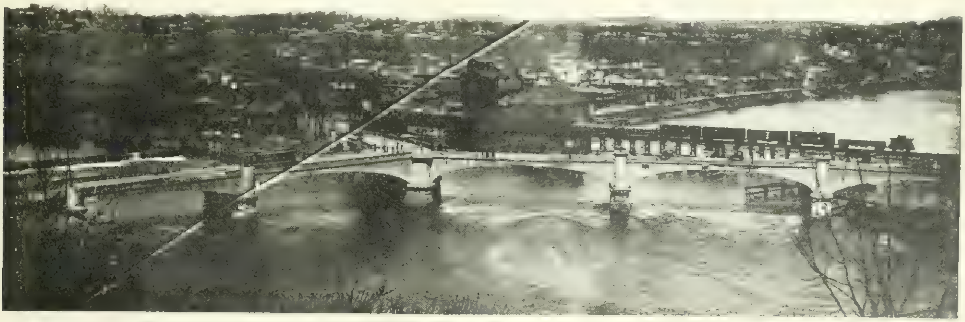


Fig. 2—The "Y" Bridge at Zanesville Was Open to Wagon Traffic Within Four Days After the Flood

This shows the bridge open to street car traffic, and the railway trestle bridge adjacent. The wrecked span of the former railway bridge can be seen at the right. Comparing these wrecked spans to the broken coping on the concrete bridge illustrate strikingly the relative value of concrete and steel bridges. Fig. 3 shows this in greater detail article—and then must edit the results. The professor in charge can handle only a few men properly, and the rest are turned over to instructors. Where the student has been allowed to write on a subject of his own choosing he often is much better informed along that line than the instructor. Sometimes the professor in charge outlines certain work, giving a part to each of several men. Often he has some idea of his own which he wishes worked out, and makes the student accept a selection, which by the way, may not interest him at all. In one of our large universities a professor of note decided to write a book. Each proposed chapter was assigned to one or more students as thesis subjects which were worked out, compiled and edited under the professor's name, without giving the individual student the least public credit for his work. This book is now a recognized standard on its subject. Some of the best known writers on strength of materials in each succeeding edition of their various books, head tables, etc., with the note, "Experiments performed by the author." Perhaps the author could have performed three or four thousand experiments between successive issues of his book, but it is not probable that he has done so. I know of two such writers at two different universities who are very rarely seen in the testing laboratory and who have no private laboratory. The student will do only enough work to have his thesis accepted, but had he been allowed to write on a subject he is interested in the literature on that subject would have been exhausted and his best work would have been presented. In writing my thesis for a Bachelor's degree, work of the previous summer with the L. & N. R. R. formed the subject. The intimate knowledge of the work, the pictures, the cost data, made a very good presentation, but there was really nothing original in the work.

Where the instructor divides one thesis into several subjects for groups of men, each group will be well informed on its own particular assignment, but will have but a superficial knowledge of the rest of the work. The average student will not interest himself in any but his part of the work. This was forcibly illustrated when writing my thesis for a Master's degree. Two men were to make tests of cements, sands, broken stone and gravel; two were to test various types of reinforcing bars; two were to investigate the bond of steel embedded in concrete; and two were allowed to make and test a number of reinforced beams. Each of these was a thesis for the two men on the respective parts of the work, and to my lot, fortunately, fell the beam tests. Much of the other work I did not become familiar with until I had been out of college three or four years. Most people think of a thesis as some kind of original work, but with the above mentioned conditions about 10% of the work may be original.

In nearly all schools the theses must be finished and accepted by the faculty on a certain date, days before graduation. The time allowed is very often too short on account of unforeseen difficulties connected with the work, or with procuring materials and test apparatus. Lack of data on similar work may be the cause of a delay as even the best method of approach may not be known. Lack of money or the illness or absence of the instructor may make a difference of weeks when even hours must be counted. Should any one or several of these drawbacks occur the work must be postponed to be finished the next year, or must be "let through" in a more or less unfinished state, and very likely the student may be unable to afford another year at college. He then loses his diploma and his thesis, and some less worthy man may take up the work where he left off and bring it to a successful conclusion.

The students themselves generally laugh at the thesis work, and one in the Commercial School of a large western university recently made the remark that "all he would get out of his thesis would be a little more use of the library," while another one makes the statement that as the thesis is elective, it is written only by those who need the credit for graduation, and so the time is, in reality, wasted.

The need of a thesis apparently depends almost entirely upon what course a man is taking. In an average class of 30 students, perhaps two or three may arrive at something interesting or worth while. In mining and metallurgy or other lines it may be more nearly worth while because of the newness of many processes and the possibility of discovering more. The same may be said of civil engineering; under this head come experiments on reinforced concrete, but it is not worth while for many subjects. On an old theme a student of marked ability might write something good—though hardly original—while a poorly opportunity for discoveries. The last part of the senior year is certainly the prepared student might succeed better in a rather new subject offering more most important in nearly every university and the subjects are the most valuable individualily, so if a student is interested in his thesis, the point must not be overlooked that he may spend more time on it than he should, thereby neglecting perhaps almost entirely other work of quite as much weight and value to him, besides the fact that if his instructor is for any reasons particularly interested as well there will be appointments, conferences, and more pressure to do more work. Again, the performance of a large number of similar experiments, on a testing machine for example, becomes almost purely mechanical and even if the instructor is very anxious to plot a smooth curve from the results, and so wants only one man to take all the readings, still the student has gained very little, for he already learned how to make these tests in his regular work.

But suppose something is discovered in any of these investigations. The information is not usually available to the public. Write to any of the state universities regarding the contents of last year's theses and consider their answers. The data may have to be collected over a number of years as the instructor may be writing a book along this very line—but even then, it may appear too late to be of any great value, or to save some concern from going to the wall, for machines or processes may have to be discarded for lack of one connecting link. Or the thesis may be bound and filed away under tons of dust because the instructor does not think it very valuable, or his book has already gone to press, yet some company may have stood ready to pay hundreds of dollars for one paragraph in that thesis. The student pays for the printing, typewriting, photographing and binding of his thesis and then donates it to the school and faculty by putting it in their hands; they can use it or suppress it, for most universities require the student to sign an agreement not to publish any part of his thesis without permission of the faculty. This agreement is illegal because the school makes no agreement in return and because the student is really under duress. He may realize this, too, but he submits because he wishes to graduate, and having his thesis accepted is one of the requirements. To quote from instructions issued to junior and seniors by two large universities: "Both the results of the investigation and the *complete thesis* are the *property* of the university, and no portion of either may be published except by permission of the dean."

The thesis then is in fact the property of the faculty, and I have observed that most pamphlets and magazine articles—not to mention books—written by instructors in American colleges were taken from student work and are not really their own, though usually so described, and not a particle of credit given to the man or men who made the investigation. These circumstances certainly add to the delays which prevent the information from reaching the public, who, as taxpayers and supporters of the school, not only have a right to the information, but have a right to demand that it be issued as rapidly as possible.

I am told by students and instructors that the Ceramics Dept. and the Agricultural Dept. of the Univ. of Ill., encourage the publication of theses, and over the names of the real authors at that. Also this is true at the Rolla School of Mines[1], but so far as I have been able to observe this condition is very rare in our schools and universities. On the other hand, only last week the architectural dept. of another large university ruled to omit the thesis work beginning with next year and to substitute more design.

In conclusion, I would suggest that undergraduate students could employ their time to better advantage if no thesis were required of them, but that for a Master's degree one or two years of practical work and a thesis chosen by the student which would be his property after graduation, would perhaps be a solution of the question.

---

[1] Rolla, Mo.

John B. Hutchings, Jr.

Louisville, Ky.

The preparation of theses occupies a legitimate position in the college course, provided the subjects are properly chosen and the work is carried on under the general supervision of a competent instructor.

The actual value of the results of any investigation or tests made by students for the theses in most cases is practically nothing except as a training for the students themselves, unless the work is thoroughly mapped out, the results checked, and the conclusions drawn by an instructor who is in direct contact with the investigation. In such a case, it is proper that the instructor, and not the student, should have credit for the results obtained. On the other hand, in the extremely exceptional cases in which the student does produce original results of value, he should receive due credit for them. The promiscuous publishing of theses, without the full consent of the authorities and a thorough inspection if not revision, of the work by them, is improper because of the danger of presenting to the public conclusions which are not borne out by facts.

As to the value of thesis work to the student, a man, after graduation, finds that his education consists not so much in the knowledge he has actually acquired, as in the ability to attack a problem and draw correct conclusions, an investigation in the laboratory, a study of social conditions, or a theoretical engineering problem. The scientific method in any such research must be thoroughly ingrained in him, as well as the method that goes into any problem in minute detail, that selects the important features and disregards the unimportant, and one that balances practice and theory. Development of the student in such directions as these should be the aim of all thesis work.

Sanford E. Thompson.

Cons. Engr., Boston.

* * *

Artificial Marble

The material described on p. 227 of the May, 1913, issue, is something I have not used personally, but so far as I can see there is no essential difference in it from the plaster known as "Keene's cement." That cement, as you know, if properly worked gives a very hard surface and can be grained or worked like scagliola to give a marble finish. I had one job four years ago where I laid some composition floors. The plasterer was an old timer and for wainscoting he got me to let him use "Keene's cement" instead of our material, and really gave a very beautiful, highly polished surface.

In Chap. IV, p. 68, "Cements, Limes and Plasters" by E. C. Eckel, published by Wiley & Son, edition 1905, Subject: Flooring Plasters and Hard Finish Plasters" it will be found that there is but a slight difference between the "Keene's cement" there described and what the German exchange has outlined. Note especially the reference on p. 76. Eckel does not speak of the sal-ammoniac, but the other features are the same. I personally think no difference will be found in the action of the plaster, as the plasterer I mentioned got marble effects by the skill with which he handled the straight product.

W. C. Edwards, Jr.

Kansas City, Mo.

* * *

New York State Jointless Concrete Road

The pavement laid last year on the Grand Island (Erie County, N. Y.) Road No. 991[1], is in very good condition. The winter was fairly severe and the pavement shows no signs of buckling. There are no horizontal cracks.

We have one longitudinal crack about 300′ long and ¼″ wide, but it does not materially injure the pavement. I will grout the crack full at once and I am sure that it will make the road as good as new.

The only defects in this pavement are that in a couple of places where we have a new fill on a high slope, the action of the river caused the fill to wash out from below and it settled from underneath the pavement. The pavement is cracked in a couple of places like this for a distance of about 55′ at each place. At one of the places a portion has settled about 5 ft. from the edge. The earth has subsided about 18 in. under the pavement.

In regard to transverse expansion joints, it appears that they would have been unnecessary in this pavement. However, I believe the patent metal expansion joint to be a very fine thing for concrete pavements, though I do not believe the joints should come to the top of the concrete. I would recommend that they be left at least ½″ lower than the finished surface so that when the pavement wears, it will not leave the metal projecting above.

I give below the report from the engineer in charge of this particular work. The above is written upon the result of my own inspection.

C. A. Rice.

Resident Engineer,
New York State Dept. of Highways,
910 Mutual Life Building,
Buffalo, N. Y.

April 17, 1913.

Mr. C. A. Rice,
Resident Engineer.
Sir:—

April 17 I inspected the East River Road No. 991. From the lower ferry south the surface is generally in good condition, although some small patches on the surface coating have stripped, and from station 130 to station 230 there is some excess gravel on the surface of the road. At a point about forty stations south from the lower ferry there is one longitudinal crack about 300′ long in the west of the road. This crack shows clear fracture about ¼ in. wide, but no subsidence; I believe it to have been a frost heave.

At station 137-20 there is a serious crack, roughly as sketched (see Fig. 1).

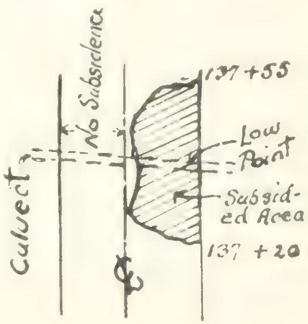


Fig. 1.

At this point the crack is about 3 in. to 4 in. and the concrete where fractured shows well. The crack is due to the subsidence of the culvert back-fill.

At station 124-35 there is a small crack roughly as sketched (Fig. 2).

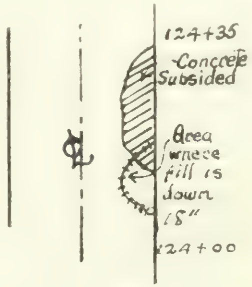


Fig. 2.

There is an area about 6 ft. long running about 5 ft. in towards the center of the road where the ground has subsided about 18 in. from the bottom of the slab. The concrete as shown in the cracks, and from underneath is A1. These cracks are caused by narrowness of shoulder, and subsidence of fill. There is a cast iron pipe under the road at this point which is now partially plugged. I imagine in the winter it was entirely stopped up. I would recommend that at both of these points the concrete slab be removed for the entire width of the road, and for such length as these defects extend, and that the base then be replaced after sub-grade has compacted.

Warner G. White.

* * *

The Development of Concrete Block

I am interested in the manufacture of concrete block and artificial stone, but the results have not been equal to the expectation.

What we need is a wider field, and in looking around for additional lines of work I am impressed with the possibilities of a system of house building which would call for reinforced parts that could be standardized as to dimensions and held in stock ready to drop into place on a building as needed.

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[1] See Sept., 1912, issue, p. 31, for description of work in progress

At present the concrete houses are poured into forms made of lumber at ruinous costs to the owner[1].

This is barbarous, yet we block men stand idle in the face of opportunities that are limitless.

If some block man had ingenuity to get up such a house he would make our business more profitable.

L. G. EMERSON.

* * *

A Sturdy Concrete Worker

In a frivolous vein allow me to call your attention to the herculean strength displayed by the laborer in the right background of Figure 9, page 189 of your Apr., 1913, issue, illustrating the very interesting article on Manufacture of Concrete Products in Germany.

The photograph shows him calmly bringing, nicely balanced in a vertical position on his shoulder, one of the columns to be placed on the base being prepared by his co-laborer!

With such men is it a wonder that such results as are described can be secured?

Incidentally, I enjoy every page including (or especially) the advertisements.

A. N. DOBSON.

Kensington, Md.

Not until Mr. Dobson brought it to our attention did we see the illusion in the picture. Yet now it appears so perfect an illusion that we are reproducing a small part of the original photograph. —EDITORS.

BEARING HEAVY MASONRY COLUMN ON HIS SHOULDER

* * *

Concrete Flower Pots

I have been making concrete flower pots of fairly large size and have found a good market for them. The forms I devised after some experiment and they work very satisfactorily. The inner form or core (Fig. 1) is simply a metal dish, slightly rounded at the bottom edge. It is made of No. 20 ga. sheet iron and at its lower rim, (the lower when the dish is upturned) it fits just inside an iron ring which I have made. The outer form (Fig. 2) is also cut from No. 20 ga. iron which is bent around the ring over the core and held by clasps. In the top of the inner core at the place where a hole is to be formed in the bottom of the flower pot, there is a ½-in. hole in the core. Over this I set a tapered plug as shown in Fig. 3, this plug being ⅞" in diameter at its big end. This is set over the hole in the core and the plug is long enough to occupy the space of the entire thickness of the bottom of the pot. To the lower end of this plug a short chain is fastened of just the right length so that a hook and lever may be used, as shown in Fig. 3,—in pulling down on the plug, thereby letting in a little air between the concrete, after the pot has been cast, and the core. The core is thus easily withdrawn from below. Withdrawing the core is made possible by the use of a rack which is built like a ladder. The flower pot in the forms sets on this rack, the ladder resting horizontally, so that the core is free. (See Fig. 4.) I have been using pit sand or gravel passing a ½" screen, mixed 1 part cement to 3 parts sand. I have been making flower pots 12", 14", 16" and 18" in diameter, using, of course, different forms for each of the pots. I am able to manufacture the 12-in. pot at a cost of 7c and sell it readily at 25c; the 18-in. pot for 15c and sell for 60c. This is possible with cement costing me $3.00 per barrel and sand at $1.00 per yd. I do all the work myself at odd times. The thickness of the walls of the pots is variable, of course, by changing the thickness of the ring which separates the core from the outer frame and of course, by using a larger outside form. I use concrete only semi-wet and the beauty of these pots as compared with clay pots is that they are very porous.

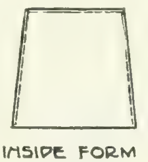

FIG. 1

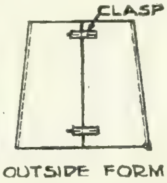

FIG. 2

HARRY E. SEXTON.

Goleta, Cal.

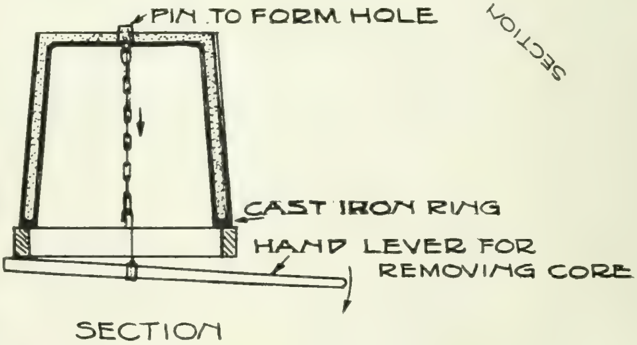

FIG. 3

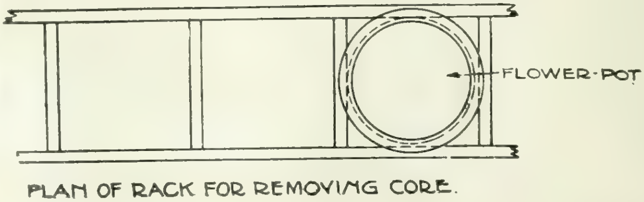

FIG. 4

Public improvements in Grand Rapids, Mich., call for the expenditure of more money for Portland cement. The product is quoted at $1.65 per bbl., as against $1.00 to $1.10 last year at this time.

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[1] Why not steel forms?—EDITORS.

House of Concrete Block, Attractive as to Color and Texture

The accompanying illustrations show the possibilities in the construction of dwelling houses with walls of concrete block, which depend for their beauty not upon any special molding or cut, but merely upon plain surfaces with attractive color and texture effects. This house, roomy and well planned, as will be seen by the drawings, and attractively finished throughout, was erected at a total cost of $7,500 of which only $2,400 was used in the masonry work, including the concrete foundations, walls, porch floors, walks and so on. The house was designed by H. H. Richard, architect, Chicago, and erected at Evanston, Ill., by A. W. Meyer, Chicago, contractor, for E. E. Olt, who is the owner. The walls from the footing to the sill course are of plain concrete block 12" thick. The block above the sill course are 9" thick and those extending from the sill to the watertable are faced with a mixture of ¼" to ½" black granite chips, black mica feldspar and Portland cement in a mixture giving great density. The block used in the upper walls are faced with a mixture containing ¼" black granite chips with white mica feldspar and a small amount of white silica sand. The lighter colored watertable and the sills and lintels are faced with a mixture containing white silica sand and coarse white granite quartz. In the manufacture of the block, the American Hydraulic Stone Co. system[1] was used and

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[1] Chicago.

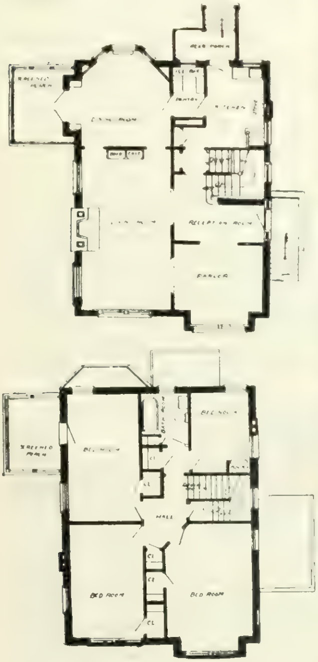
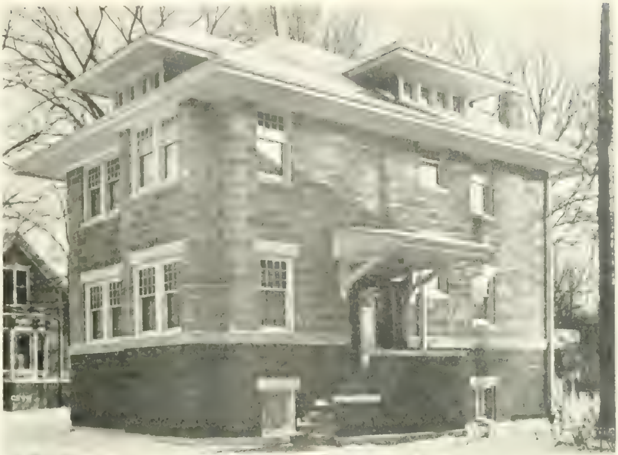
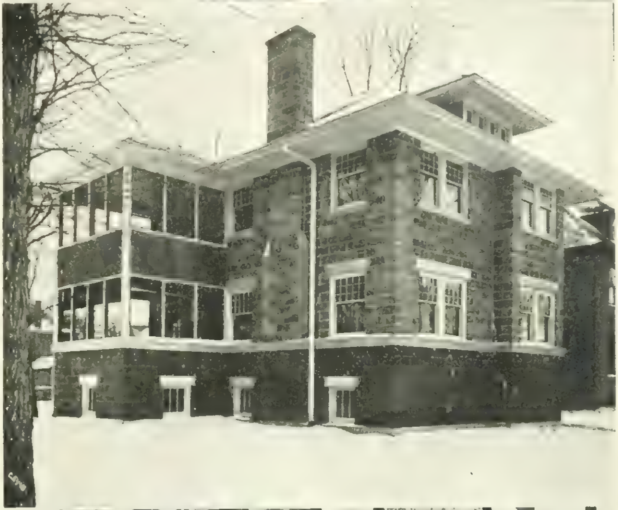


Fig. 4—First and Second Floor Plans





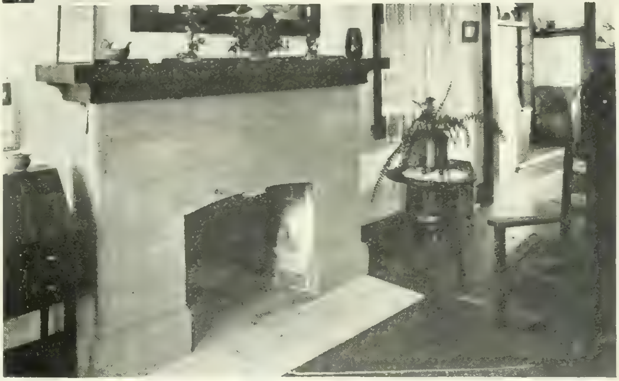


Fig. 1—Evanston, Illinois, Concrete Block House

Fig. 2—Shows Screened Porches and Concrete Chimney

Fig. 3—Fireplace in Evanston House

Illustrations, courtesy Universal Portland Cement Co.

the block were manufactured at the site of the work, using labor without any special skill. With this equipment the molds filled with concrete pass under a press applying a pressure of 150,000 lbs. In this case, the block were turned over from the pallet after about 12 hours and the face brushed lightly and washed with water. They were cured by sprinkling. Three men were required in operating the machine, making 350 faced block or 500 common block in a day. The block are T-shape in horizontal section, the web extending from the outside face to the inside of the wall, bonding what are really two walls with an air space up and down and around the structure. The chimney is also of concrete block, the flue linings cemented to the inner face. The fireplace is built of rough concrete block and veneered with specially faced 4-in. slabs. These facing block show red and yellow marble chips, broken onyx, black mica feldspar, and orange and yellow silica sand. The general effect is a tan color with a great deal of life and sparkle. The work done in the manufacture of the block for this house merely serves to illustrate the possibilities which are open to builders and architects in specifying surface colors and textures, which they want in their buildings when concrete block are used.

The Production of Cement Since 1880

The recent growth of the American Portland cement industry has been so rapid that its present relative standing among our great industries is realized by few, even of those directly interested. Its importance, both commercially and financially, is perhaps best brought out by comparison with the American iron industry, whose standing is everywhere fully understood. The following table compiled by E. C. Eckel of the U. S. Geological Survey, gives the output of pig iron and Portland cement in long tons in every fifth year from 1880 to 1910, inclusive.

COMPARATIVE GROWTH OF CEMENT AND IRON INDUSTRIES

Year	Pig iron long tons.	Portland cement, long tons.	Percentage of cement to pig iron.
1880	7,749,233	7,000	0.1
1885	7,415,469	25,000	.3
1890	9,202,703	56,000	.6
1895	9,446,308	165,000	1.7
1900	13,789,242	1,414,000	10.3
1905	22,992,380	5,874,469	24.3
1910	26,674,123	12,986,152	48.7

The Dravo Construction Co., Pittsburgh, has been awarded the contract for building the reinforced concrete bridge over the William Pitt Blvd. at Murray Ave., to be known as the Murray Ave. bridge. The Dravo Co. with a figure of $98,205, was one of the three firms which submitted bids. The others were: Charles H. Nold Company, $99,554.50; Duquesne Contracting Co., $140,656. The structure will be of steel and reinforced concrete. It will be 375′ long, 60′ wide and will have a main will be two 12-ft. sidewalks.

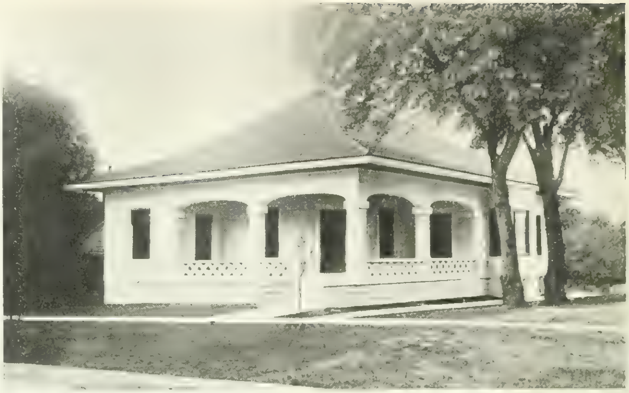


FIG. 1—CONCRETE BLOCK COTTAGE USING WHITE FACING MIXTURE

Cottage Built of White Face Block

The illustrations show the home of A. L. Huntington at Creston, Ia., built of concrete block with equipment manufactured by W. D. Moore & Son, Creston. The house shown is 36′ x 50′ in plan and it cost, complete, $5,900. The block used are 24″ long, with smooth face. The block forming the body of the house are faced with white cement and dark granite. All the trim, including the frieze, caps, sills, corners, window and door jambs, are faced with a mixture of white cement and white sand, and when laid up, project 1″ from the walls. The arches over the porch openings are not of concrete block although given that appearance in the method of finish, but are of Portland cement plaster on metal lath. The block used to form the porch balustrade were made in wooden molds 16″ x 16″, each arm of the block being 5″ x 5″. The floor of the porch, which is of reinforced concrete, has a surface of white cement and dark granite. The fireplace shown in Fig. 3 is of concrete. The hearth was cast in place and the upper portion is in three pieces, factory-made. In this work a mixture of white cement and dark granite was used for facing.

Merrill Moore was the designer and contractor for all the concrete work; all of this, below grade, cost $1,400. W. D. Moore & Son are now pushing the wet process block equipment more than the equipment which requires tamping, but when this house was built a couple of years ago, practically all of the trim

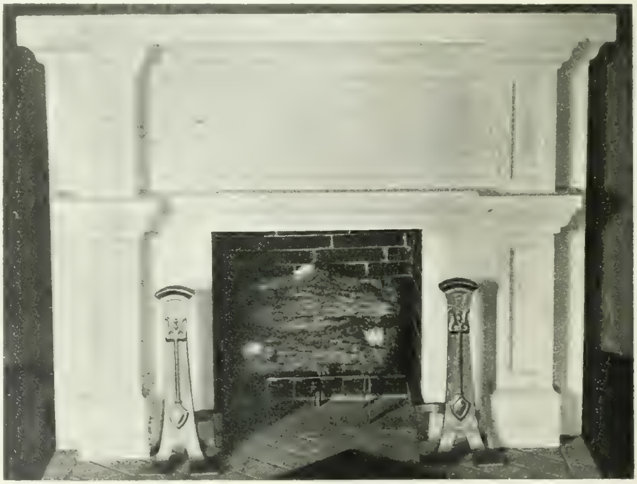


FIG. 2—CONCRETE FIREPLACE PRE-CAST IN THREE PIECES

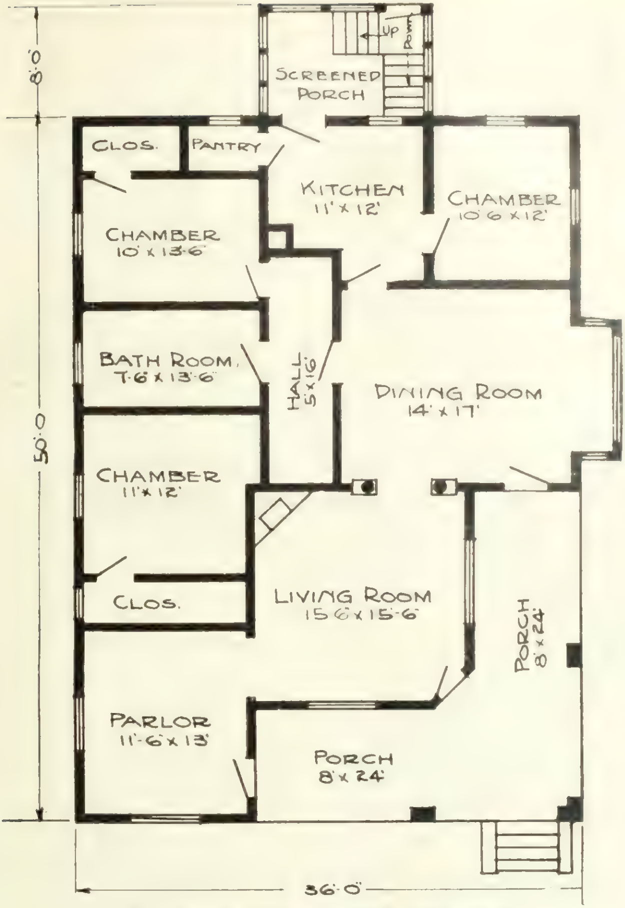


Fig. 4—Plan of Creston, Ia., Concrete Block [illegible]

and some of the other block used in the work, were made by the tamp method.

Boiler Tube Floors

In a recent issue of the *American Machinist,* H. K. Scholefeld describes as follows the construction of a factory floor from old boiler tubes:

A quantity of 4-in. boiler tubes 18' long were laid down side by side, supported at the ends only. About 2 in. were left between each pair of tubes. Some planks were placed beneath the tubes to retain the concrete while setting. The planks were made to touch the underside of the tubes without lifting them off their supporting joists.

A rich concrete was poured over the tubes, and found its way between and around them; this was laid to a depth of 2" above the tubes. Afterwards, the planking was taken down, which left a floor remarkable for its lightness, strength and elasticity.

Specifications of the National Association of Cement Users

The Natl. Assn. of Cement Users has sent out to letter ballot the following specifications:

1. Proposed Standard Specifications for Portland Cement Stucco.
2. Proposed Standard Methods for the Measurement of Concrete Work.
3. Proposed Revised Standard Specifications for Plain Concrete floors.
4. Proposed Revised Standard Specifications for Reinforced Concrete floors.
5. Proposed Revised Standard Specifications for Portland Cement sidewalks.
6. Proposed Revised Standard Specifications for Concrete Roads and Street Pavements.
7. Proposed Revised Standard Specifications for Portland Cement Curb and Gutter.

The various changes in these specifications were discussed in detail in the Jan., 1913, issue in the report of the last convention. The ballot will be canvassed June 1.

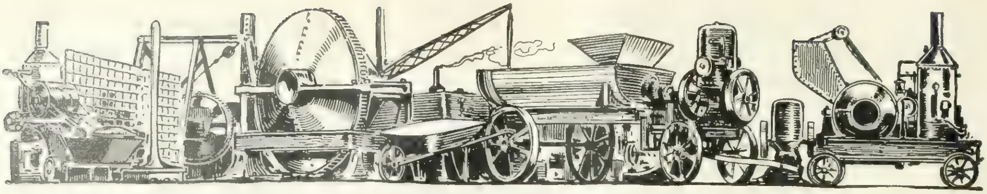
Baptismal Font in San Gabriel Mission—A Primitive Work in Concrete

Some Primitive Concrete Work in California.

The accompanying illustration shows some concrete work more than 100 years old. Of course it is not concrete work, as the term is now understood, and the work was done at a time when white men were strangers to Portland cement concrete, and even to the puddled mud which was used extensively in the part of the country where the picture was taken. The illustration shows an alcove in the San Gabriel Mission, near Los Angeles, Cal., with the baptismal font occupying a central position. This font stands within walls which are more than 4' thick. The font is about 18" deep, and an old San Gabriel Indian says that it was made by puddling mud in a box of wattle work lined with adobe bricks. The mud was strengthened by mixing with it a certain amount of rock which was brought by the Indians from the mountains near where the cement factories at Colton, Cal., now stand. The Indians powdered this rock by grinding it between two harder rocks by a very laborious process; in fact, the work was so laborious that this particular mixture of materials was seldom used except when utensils were wanted to contain water. The lid of the vessel is made of hammered copper.

San Gabriel mission was founded in 1770. A squad of soldiers guarded the workmen while they were building the structure. Before the work was completed, the Indians attacked the laborers and an old chief was killed by a soldier. It is said that the youngest son of the Indian who was killed at this time was the first to be baptized at this fountain.

Some years ago, when the San Gabriel Mission was rehabilitated, the ex-with a coat of Portland cement mortar. There is a possibility that the original cement made by grinding the rock was a silica-lime cement.



New Equipment, Methods and Materials

In this department the Editors endeavor to keep our subscribers informed upon new tools, methods, machines and materials used in this industry. It is in no sense a department for the benefit of advertisers. To secure attention the thing described must be new to our readers. No matter will be printed simply because an advertiser desires it. Likewise, no matter will be excluded simply because the article described is not advertised in this paper. We aim to keep our readers informed—suggestions for the improvement of this department are solicited.

Paving Mixer

After three years of constant study and application of the street paver problem, the Chain Belt Co., Milwaukee, now announces as ready the Chain Belt street paver.

This is of the same general design as the company's standard side discharge Chain Belt mixer.

The street paver has a Chain Belt drive; cast semi-steel bulge drum, chilled rollers with bronze bushings, all-steel frame, etc.

This machine was especially designed for laying concrete pavements but it can be used for any class of work and is well adapted for mixing concrete for bridge abutments, etc. It is provided with a reversible traction drive, so that the mixer can be moved forward or backward by its own power. The traction drive is fitted with a friction clutch, and to move the machine ahead it is necessary only to throw in the clutch, and to stop the machine, throw out the clutch. The traction drive is connected to both rear wheels and is sufficiently powerful to propel the machine up an incline of 15°. The front axle is of the automobile steering knuckle-joint type, and the rear axle is a compensating differential. The latter is advantageous in that it will equalize the speed of the rear wheels in turning corners—wheels are heavy crucible steel castings 9″ wide.

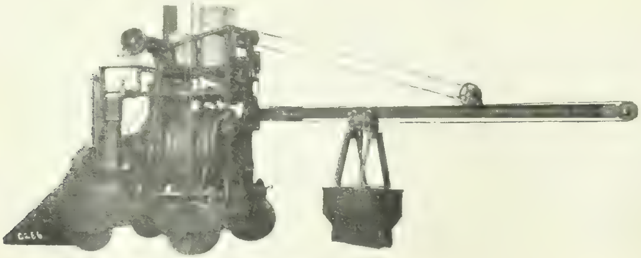
No platforms or runways are required and if the material is placed sufficiently close to the machine it can be shoveled directly from the supply pile to the open end power loader bucket. All levers are so arranged that one man can operate the entire machine if necessary. The operator stands on a platform on one side of the machine, about 30 in. above the ground, and can operate the power loader, water tank, discharge and boom. The Chain Belt paver is announced as capable of turning out a batch of concrete in 45 seconds. The paver is equipped with a boom 20′ long and a delivery bucket. Paving contractors have found this an economical method of spreading concrete on streets, as it eliminates the use of wheelbarrows and carts.

The concrete is discharged from the mixer into the delivery bucket, which travels on a single boom. The boom can be swung at an angle of 180°. The boom bucket will hold a full batch of the mixed concrete and is provided with an automatic tripper, and the gate opens up automatically at any place where it is desired to deposit the concrete. When bucket returns to the mixer the gate closes automatically. The same man who operates mixer levers also controls the movements of the boom and bucket.

In work where the road is less than 18′ in width a gravity swivel chute may be substituted for the distributing boom.

The Chain Belt paver is made in three sizes: 10-, 15- and 23-ft.

The No. 10 weighs 11,000 lbs., the No. 15 weighs 14,000 lbs. and the No. 23 weighs 17,000 lbs.



Paving Mixer

* * *

The Cummings Structural Concrete Co. has removed to new offices in the Machesney Bldg., Pittsburgh.

Using a Waterproofing Compound With Lean Stucco Mixtures

Permanently satisfactory stucco work is an end toward which contractors have been working for some time, and many different opinions exist as to the best mixture for stucco. The Standard Paint Co., N. Y. C., in a circular recently sent out, calls attention to what is, in its opinion, the necessity of using leaner mixtures in stucco. This company manufactures "Impervite," a waterproofing compound, and recommend its use in stucco mixtures. The following paragraphs are quoted from its recent circular:

"Outside of settlement cracks, the chief cause of disintegration of stucco is the alternate expansion and contraction due to wetting and drying out. It has been proven that mortar contracts on drying (and expands on wetting) just as lumber does. This action keeps up for years, and is one of the principal causes of cracking, especially in stucco. It is the cement, however, which is affected, and not the sand; therefore, if the cement is diluted with a large proportion of sand the total effect is greatly reduced.

"Experience shows that a plain 1:3 stucco, properly applied, is safe from cracking, but is very porous. A 1:2 stucco, however, while less porous, is very much more liable to crack in spite of the greatest care in workmanship.

"This, then, is the dilemma which confronts the constructor; how to make a stucco lean enough to avoid cracks, yet non-porous enough to keep out water. The problem has been solved by the use of 'Impervite' as a waterproofing agent with a 1:3 stucco.

The leanness of the mortar prevents cracks, and the "Impervite" makes the mortar waterproof. This gives, the manufacturers claim, reliable results, both as to permanency of surface and permanency of waterproofing

* * *

The McCoy Silo Co., Pittsburgh, has been granted a state charter. The concern manufactures forms in wood and steel for building concrete silos, tanks, grain elevators, stacks, bridges and buildings. The incorporators are John H. McCoy, Pittsburgh; Eugene E. Wicks, Harrisville, Pa., and Jerry McCoy, Knox, Pa. The company is capitalized at $25,000.

A Silo Stave Machine

A machine for the manufacture of concrete staves of unusual and interesting design has been put on the market by the Improved Cement Stave Silo Co., Cassopolis, Mich. Each stave of the regular pattern is 2½" thick, 10" wide and 28" long. The upper edge and one of the side edges are convex, the lower edge and the other side are concave and the edges fit together in tongue-and-groove fashion when erected. It will be seen by Fig. 1 that these staves are not rectangular, but are of such shape and fit together in such a way that when put into the wall, each side is locked into position by six other staves. With the concave and the convex edges it is possible to put the staves together in such a way that silos of various diameters are possible. Fig. 2 shows the silo 14' in diameter and 40' high built of these staves at the farm of H. D. Gleason, near Williamsville, Mich. The concrete used in making the staves is 1 part cement to 3½ parts gravel, and it is said that four men using the machine shown in Fig. 3 can manufacture 500 staves in a day. Manufacturers also say that by actual experiment it has been shown that with the labor of four men for five days it is possible to erect a silo 16' in diameter and 35' high, including the foundations, all the manufacture of the staves and all the work except putting on the roof and chute. As will be seen in Fig. 2, the courses of staves are held in position by bands and lugs which encircle the silo at each course in such a way as to overlap the staves at their end joints. When all is in place, the silo is covered on the inside with a cement wash, giving a tight job.

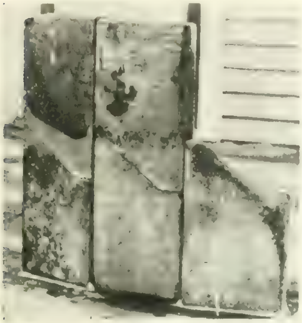


Fig. 1—A Sample Panel Showing How Silo Staves are Joined

As evidence of the tightness of the work, it is said that the staves may also be used successfully in building stock tanks, watering troughs and so on. The patents also cover the construction of the doors and frames, parts of which are made in units similar to the staves.

* * *

Westinghouse, Church, Kerr & Co. are now situated in their new offices at 37 Wall St., N. Y. C. The move was made necessary by greater space required for the constantly increasing business of this company.

* * *

Robert A. Cummings announces the removal of his Pittsburgh office to the Machesney Bldg., Pittsburgh.

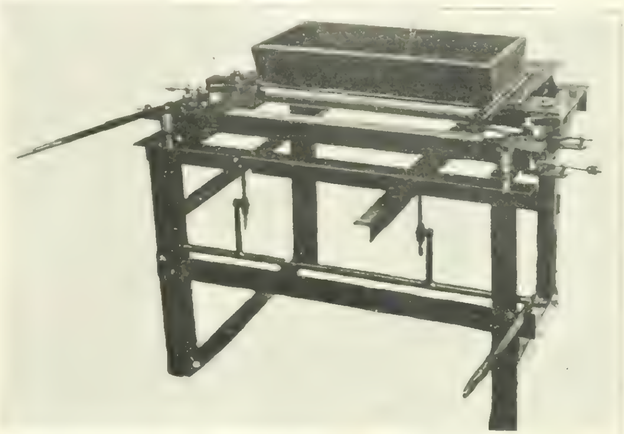


Fig. 3—A Sample Machine with Shallow Molding Frame in Which Staves are Made

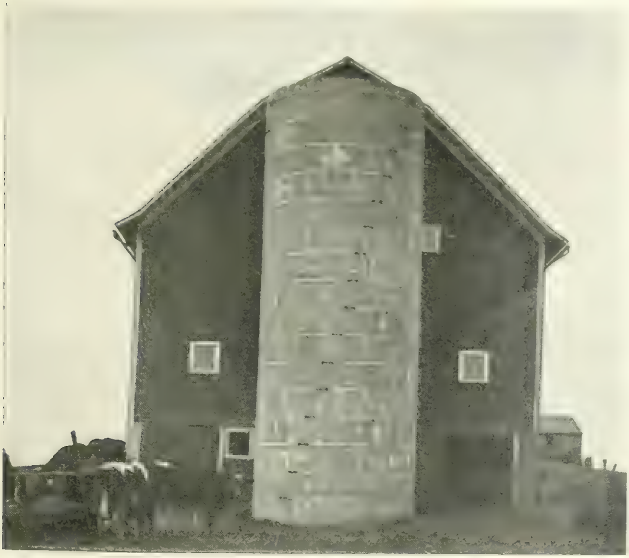


Fig. 2—Silo at Farm Near Williamsville Mich

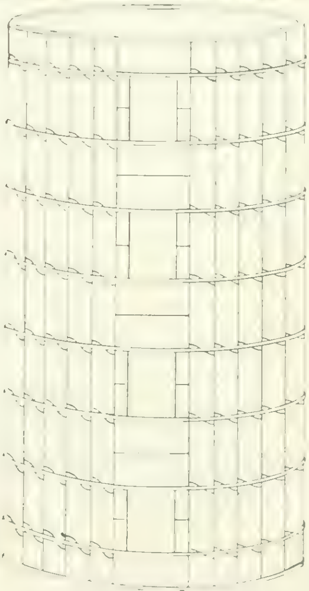


Fig. 4—Elevation Sketch of Stave Silo

Mastic Flooring for Industrial Plants

One of the details of modern factory construction which is, at the present time, demanding careful consideration is that of the floors. The H. W. Johns-Manville Co., N. Y. C., is placing upon the market a material known as "J-M Asphalt Mastic," which, when combined in the proper percentages with a finely graded mineral aggregate in the shape of washed torpedo gravel, torpedo sand, crushed limestone or granite, produces a floor suitable for factory purposes.

The manufacturers state that these floors can be made of any consistency between extreme hardness and softness, and, while always dense, possess a certain amount of resiliency which adds greatly to the comfort and efficiency of those who are compelled to stand at work. They are noiseless and have a peculiar holding quality which tends to prevent slipping. They are also acid-, alkali-, brine- and water-proof, and being water-proof they can be readily cleaned by flushing, making them sanitary. Their nature is such that they do not originate dust. Where repairs may be necessary due to changes in the floor surface these repairs can be easily effected.

These floors may be laid to any thickness desired and are ordinarily applied from 1" to 3" thick, depending entirely upon the conditions to be met. They can be laid over any foundation which is firm and stable, such as wood, brick, tile or concrete, although in new buildings concrete is most desirable. They do not add greatly to the dead load, weighing only 12 lbs. to the sq. ft. 1" thick.

In applying this mastic floor the surface of the concrete or other base over which it is to be laid, must be clean and dry. The mastic is delivered on the ground in blocks which are broken up and melted in suitable boilers and, when brought to the proper temperature, the necessary amount of mineral aggregate is added and thoroughly mixed, after which the material is applied to the floor.

* * *

The Electric Welding Co. announces the removal of its Pittsburgh office to the Machesney Bldg., Pittsburgh.

The Wheeling Mold & Foundry Co., Wheeling, W. Va., announces that since May 1 it has been offering both a 5-ton and a 7-ton tandem road roller in connection with its present complete line of stone-crushing machinery. This roller is already favorably known. It was designed by two engineers of wide experience in road rollers, and for the last two years has been controlled by the John A. Donahue Co., Chicago. Mr. Donahue will continue to sell the roller through his present organization.

* * *

To take care of a constantly increasing business the Yale & Towne Mfg. Co. announces the removal of its general offices from 9 Murray St. to 9 E. 40th St., N. Y. C.

* * *

A Motor-Driven Bar-Twisting Machine

The bar-twisting machine shown in the accompanying illustration will twist concrete bars ranging in size from 5/16" to 1¼" sq., advancing by ⅛", with a maximum length of 60'. The pitch of the twists in the bars can be regulated by the operator, and is indicated on a registering revolution counter which is reset at zero by hand, at the beginning of each twisting operation.

High speed gears are provided for small bars and low speed for larger sizes. The speed is easily changed from one to the other by shifting a jaw clutch

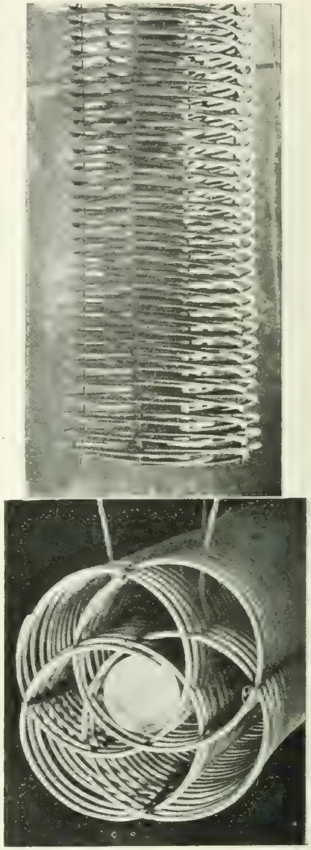
The twisting heads are arranged to receive tool steel dies which fit the various sizes of bars which the machine twists. The twisting head speed is about 60 r. p. m. for 1¼-in. bars. About one minute is consumed in twisting the bars and about two minutes in changing them, making the complete cycle require about three minutes.

Several of these machines are in use in this country and one is now being built at the company's works at Groveton, Pa., for export to Germany.

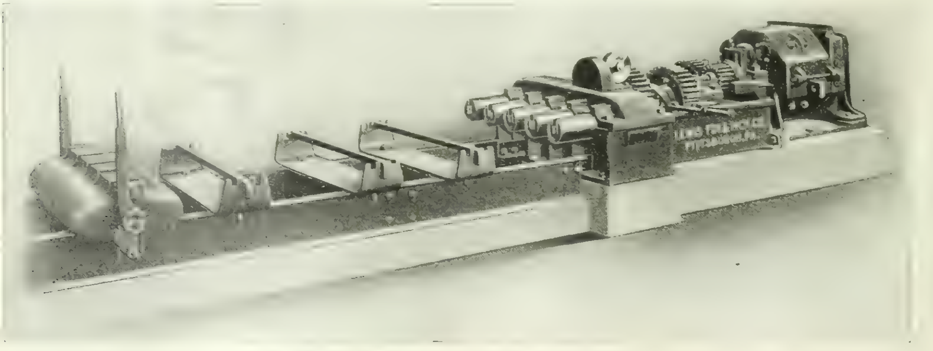
The machines are equipped with 75 h. p. Westinghouse motors for the 1¼-in. sq. bars and 60 h. p. motors for machines twisting a maximum bar 1⅛-in. square. The machine is built by the Lewis Foundry and Machine Co., Pittsburgh.

Intercepting Spirals as Column Reinforcement

The accompanying illustrations show a form of column reinforcement that excited much interest at a recent exhibit of building materials in London.



Intercepting Spirals and Solid Core for Column Reinforcement



A Bar Twister Operated by a Direct Connected Motor

The arrangement of the intercepting spirals is plainly shown in the illustration. According to *Concrete and Constructional Engineering* (London), to which we are indebted for the accompanying illustrations, this type of reinforcement has more than double the strength obtainable from any other combination of steel and concrete in which the same weights of these materials are employed. The illustrations show the nature of the construction, with anchored spirals and a central steel core, and it is worthy of notice that the latter is so designed as to be —when braced by the anchored spirals and the encasing concrete shaft—sufficient to carry the whole of the structural load during construction. This expedites construction by making it unnecessary to wait for the columns to develop full compressive strength. An extensive series of tests has been carried on by Prof. Andrew Gray, of the Univ. of Glasgow, Scotland, and in a report he says of this method that it "provides a composite material having the remarkable and extremely valuable physical property that its modulus of elasticity under progressive loading increases with the increase of compressive stress."

Apart from its practical value, it is thus, on account of this remarkable and unique property, of great scientific interest. Other columns which were tested to destruction carried loads as great as 1,430 tons per sq. ft.[1] of reinforced area. Copies of Prof. Gray's report and other particulars can be obtained on application to Reinforced Metal, Ltd., 175, West George St., Glasgow, Scotland.

* * *

"Dri-Crete" Waterproofing Compound

A recent waterproofing material put on the market is "Dri-Crete," handled by the Dri-Crete Co., Inc., N. Y. C. This material is a thin, light-colored liquid. It is, the manufacturers state "as thin as water and as white as milk." It is further stated that there is no odor to this material and that it will not change the color of any surface to which it may be applied.

For stucco work such as basements, cellars or in any surface under ground, "Dri-Crete" waterproofing compound can be used in place of water. The mortar so made should be applied to the walls by waterproofing in a thoroughly workmanlike manner, following best practice for this kind of work. If there is any possible lack of bond the old wall should be chipped and the waterproofing mortar applied ½" thick on walls and 1" thick on floors.

For exterior surfaces Dri-Crete is put on with a brush usually in two coats with 20 min. intervening between the coats. One gal. of this material will, it is claimed, cover about 15 sq. yds. of surface.

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[1] Assuming this to mean the short ton of 2,000 lbs., it would mean a total load of 2,860,000 lbs. or 19,860 lbs. per sq. in.

NEW BOOKS

Fourth Report of the Illinois Highway Commission. 1910-1911-1912. Illinois Highway Commission, Springfield, Ill. 9" x 6", paper, 345 pp., illust.

This is a valuable book covering the work of the Highway commission in great detail and giving much cost information.

* * *

Good Roads Year Book. 1913. American Highway Association, Washington, D. C. J. E. Pennybacker, Jr., Editor. 6" x 9¼", cloth, 548 pp., $1.00.

This is the second annual issue of a work, country-wide in scope, which should be of interest and value to all students of road building, road legislation and administration. It covers the progress of road work in the states. This is preceded by a brief history of road building and a summary of foreign road systems. It describes types of roads; discusses design and construction of bridges and culverts; gives lists of highway officials by states, a summary of highway engineering work in colleges and universities and includes a bibliography of federal and state publications on roads; lists patents, trade names; reports on convict labor in road building; lists Good Roads associations, contractors and manufacturers in the highway building field and lists the members of the American Highway Association.

* * *

Specifications for Street Roadway Pavements. S. Whinery. Second revised edition. 9¼" x 6¼", 116 pp., cloth. McGraw-Hill Book Co., N. Y. C. Price $1.00.

This work covers practically every type of pavement now in use and besides discussions of specifications in general and the relations of contractors, engineers and so on, it goes on to describe the preparatory work in paving and follows constructions through in detail. Part II of the book—a matter of 25 pages—is given over to instructions to inspectors.

* * *

The Manufacture and Properties of Hydrated Lime. Richard K. Meade, Baltimore, 9" x 6", paper bound, 16 pp., illust.

Hydrated lime is coming more and more into general use, and this booklet, which is a reprint of a paper read by Mr. Meade before the Am. Inst. of Chem. Engrs., is an interesting and detailed discussion of the subject presented in the title. Practice since 1910, when the paper was read, has changed very little, and the pamphlet as published is still a standard text on the subject.

Asphalt Construction for Pavements and Highways. Clifford Richardson. [illegible] 151 pp., flexible covers. Price $2.00. McGraw-Hill Book Co., N. Y. C.

This is a "pocketbook for engineers, contractors and inspectors" on the various details in the application of asphalt to streets and highways.

Concrete Organizations, Officials and Conventions

National Association of Cement Users, Edward E. Krauss, Secretary, Harrison Building, Philadelphia, Pa. Convention, Chicago, Feb. 16-20.

Association of American Portland Cement Manufacturers, Percy H. Wilson, Secretary, Land Title Building, Philadelphia, Pa.

American Highway Association, J. E. Pennybacker, Jr., Secretary, Colorado Building, Washington, D. C. Meets as part of American Road Congress, Detroit, Sept. 30-Oct. 6.

Northwestern Cement Products Association, J. C. VanDoorn, Secretary, Security Bank Bldg., Minneapolis, Minn.

Cement Products Exhibition Co., 72 West Adams St., Chicago, Ill.; Secy.-Treas., J. U. C. McDaniel, 108 La Salle St., Chicago, Ill. CHICAGO Show, Coliseum, February 12-21, 1914.

Nebraska Cement Users' Association, Secy.-Treas., Frank Whipperman, Omaha, Neb.

Iowa Association of Cement Users, Henry H. Dean, Glenwood, Ia., Secretary.

Canadian Cement and Concrete Association, William Smith, Secretary, 57 East Adelaide St., Toronto, Ont.

American Road Congress to be Held in Detroit

Detroit has been selected as the place at which the next convention of the American Road Congress will be held, the date being the week of Sept. 29. Sessions of the convention will be held at the Hotel Pontchartrain and the exhibits will be shown at the Wayne pavilion, where all the available space will be required.

It is estimated that the attendance will be between 6,000 and 8,000. The widespread interest in the concrete roads of Wayne county and the many attractions offered by Detroit as a convention city should have the effect of making the convention the largest of its kind ever held. Pres. Philip Cosgrove, of the Michigan Good Roads Assn., was present at the meeting at which it was decided to bring the convention to Detroit. The state organization will hold its own meetings at the same time as the Congress and the Ontario (Canada) Association will be in session at the same time at Windsor, directly across the river from Detroit. The U. S. government will have an extensive exhibit at the pavilion and applications for exhibit space are already being made by manufacturers of road machinery and equipment.

Three organizations, working together, are responsible for the success of the Congress—the American Highway Assn., the American Automobile Assn. and the Natl. Assn. of Road Mchy. and Material Manfrs. The Congress has been one of the most important of all factors in arousing and maintaining public interest in Good Roads, and its sessions attract delegates and guests from all over the world.

President Wilson, Secretary of Agriculture Housten, Gov. Ferris, of Michigan, and Gov. Dunne, of Illinois, have been invited to be present, and there is little doubt that they will accept.

The Congress offers an excellent opportunity to see and hear the best modern status of road-building and incidentally gives a chance to demonstrate the admirable qualities of the concrete roads of Wayne county, which are noted the world over. Further details of the Congress, its convention program and the exhibits will be published from time to time.

An International Engineering Congress, 1915

In connection with the Panama-Pacific International Exposition which will be held in San Francisco in 1915, there will be an International Engineering Congress, in which engineers throughout the world will be invited to participate.

The Congress is to be conducted under the auspices of the following five national engineering societies: Am. Soc. of Civ. Engs., Am. Inst. of Min. Engs., Am. Soc. of Mech. Engs., Am. Inst. of Elec. Engs., and The Soc. of Naval Archs. and Marine Engs.

The papers presented at the Congress will naturally be divided into groups or sections. During the Congress each section will hold independent sessions, which will be presided over by a chairman eminent in the branches of engineering covered by his section.

The scope of the Congress has not yet been definitely determined, but it is hoped to make it widely representative of the best engineering practice throughout the world, and it is intended that the papers, discussions and proceedings shall constitute an adequate review of the progress made in the last decade and an authoritative presentation of the latest developments and most approved practices in the various branches of engineering work.

The various committees are now actively at work, and it is hoped that further and more definite announcements as to the membership fees, schedules of papers, etc., can be made in the very near future. The executive offices of the Congress are in the Foxcroft Bldg., San Francisco. W. F. Durand is chm. of the executive committee.

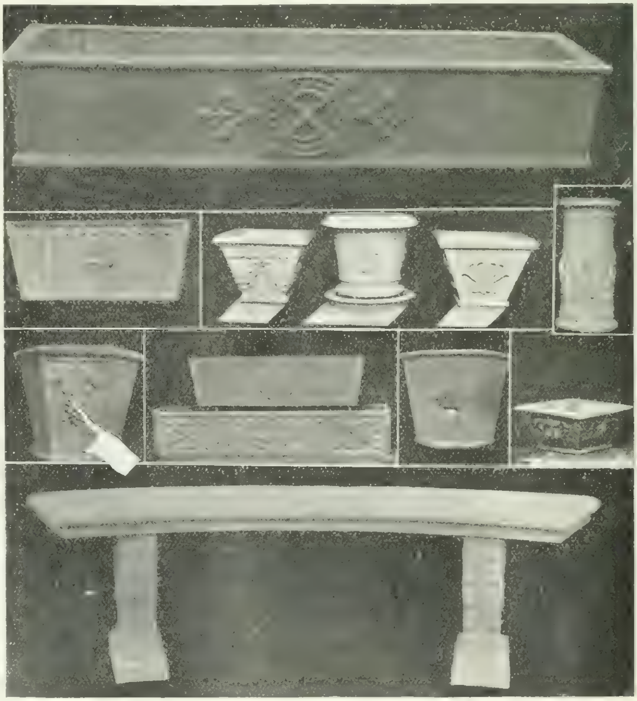
Ornamental Concrete Products—Suggestions from Germany.

Great progress is being made in Germany in the manufacture of concrete products, especially in ornamental and architectural pieces. Julius Ruoff, of the Ruoff Construction Co.,[1] has recently returned from Germany where he spent some little time studying the methods abroad. Some of the work of the Ruoff Construction Co. in the line of garden ornaments and so on, has been described and illustrated heretofore.[2] The company has built up a large business in Philadelphia in making garden ornaments which are in big demand and are on sale in large department stores.

In writing of the progress in Germany, Mr. Ruoff mentions particularly the fidelity with which the Germans follow the instructions of architects along special lines. He says it is very common for the products manufacturer to receive from the architect samples of natural stone, which it is expected they are to reproduce as to color and texture and general appearance, in concrete. In doing this work, much of the stone is dressed by hand or machinery after it comes from the molds.

Mr. Ruoff says there is a big demand in Europe for a hard pressed concrete tile, 18" x 18" and 2" thick, for use in the construction of floors. In making the tile, a facing mixture is used consisting of basalt screenings and Portland cement. Hydraulic presses and knee lever presses are used in their manufacture. They are made in four or five different colors and the output of some of the machines is 400 to 500 tile a day. The tile are also made in sizes smaller than that mentioned, particularly for use in smaller floor areas, and a common dimension is 7⅞" x 7⅞" x 1" thick. Another project used extensively in Germany and manufactured with great success, is a polished artificial stone step. These are factory-made in any desired length, rise and tread, and are polished on their exposed surfaces.

The accompanying illustrations show some of the recent work of the Ruoff Construction Co. Mr. Ruoff has been doing a great deal of experimenting with small colored concrete tile which are inlaid in many of his products. In curing his concrete, Mr. Ruoff uses a large reinforced concrete tank in which he keeps the products immersed in water for several days. When they first come from the men they are kept in a stock room covered with damp burlap and later are transferred to the tank.



CONCRETE FLOWER BOXES, URNS, VASES AND A GARDEN SEAT MADE BY THE RUOFF CONSTRUCTION CO.

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[1] Second & Butler Sts., Philadelphia

[2] [illegible], page [illegible], [illegible], [illegible]

A Severe Test of Paving Slabs

(Continued from Page [illegible])

and of that part of the test conducted in Chicago is furnished by the Universal Portland Cement Co., as follows:

All concrete sections were of the same size, approximately 6′ 4″ x 4′ 2″ x 3′ 6″ wide and 4″ thick, reinforced at the center to prevent breaking in handling, with American Steel & Wire Co.'s[1] triangle mesh, style No. 28. Ten sections of this size with an 8-in. space between them, formed a circular ring 3′ 6″ wide having an outside radius of 11′ 3″.

The concrete sections were all made in the week of Nov. 19 to 26, 1912, using Universal Portland cement, clean, coarse sand and a coarse aggregate, either screened, washed gravel, crushed limestone or crushed granite. The concrete was well mixed by hand with sufficient water to produce a medium wet consistency, lightly tamped into the forms, the surface struck off with a straight-edge, finished with a steel trowel and then slightly roughened by brushing with an ordinary broom. The sections were cast indoors where the temperature varied during the time they were curing, from close to freezing, to about 70° F. All sections were kept well sprinkled with water for three days, and between Nov. 29 and Jan. 16 were sprinkled on two different occasions. The description of sections follows:

Test Sections

Section No. 1. 1 part cement, 1½ parts sand and 3 parts ¼″ to 1½″ screened, washed gravel; one edge of section protected with Baker[2] metal plate.

Section No. 2. 1 part cement, 1½ parts sand and 3 parts of a mixture composed of 4 parts 1″ to 1½″ and 3 parts ¼″ to 1″ crushed Wisconsin granite.

No. 3. 1 part cement, 2½ parts sand and 5 parts ¼″ to 1½″ screened washed gravel.

No. 4. 1 part cement, 1½ parts sand and 3 parts ¼″ to 1″ crushed limestone.

No. 5. 1 part cement, 2 parts sand and 4 parts ¼″ to 1½″ screened washed gravel, one edge of section protected with Baker[2] metal plate.

No. 6. 1 part cement, 2 parts sand and 3 parts ¼″ to 1½″ screened washed gravel.

No. 7. Wearing surface 2″ thick, 1 part cement, 2 parts clean coarse sand; base a 1:3:5 gravel concrete.

No. 8. Wearing surface 2″ thick, 1 part cement, 2 parts of a mixture composed of 1 part ¼″ granite screenings and 2 parts ¼″ to ¾″ crushed granite.

No. 9. 1 part cement, 1½ parts sand and 3 parts ¼″ to 1½″ crushed limestone.

No. 10. 1 part cement, 2 parts sand and 4 parts ¼″ to 1½″ crushed limestone.

No. 11. 1 part cement, 2 parts sand and 4 parts crushed granite same as used in section No. 2.

The Test at Chicago

The sections were placed on about 3″ of stiff cement sand mortar.

The machine was started at 8 p. m. Jan. 16, and during the seven days of the Cement Show, ran for a total of a little over 63 hrs., each wheel in that time making 18,978 complete revolutions, the speed of the wheels varying from 3.06 mi. per hr., when traveling the inner circle of the path, up to a maximum speed of 3.86 mi. per hr. in traveling the outer circle.

Between 8 p. m. Jan. 16, and 2.30 p. b. Jan. 18, the machine made approximately 3,000 revolutions, it being necessary in that time to shut down four or five times an hour to repair the macadam section[3] which was badly torn up by the wheels and the horseshoe plungers. Saturday morning, Jan. 18, the macadam section was torn out and replaced with concrete section No. 6, and a section of

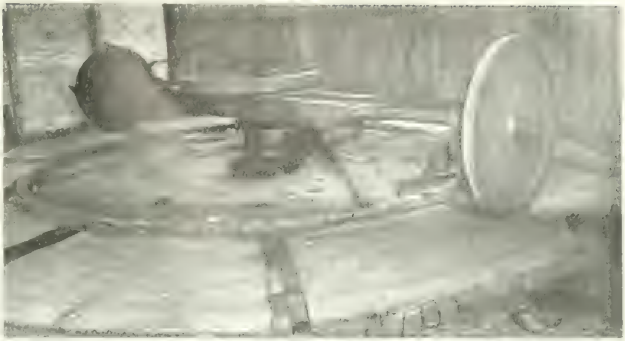

Fig. 7—(Top) This Shows Sections Nos. 1 and 2 Before the Start of the Detroit Test. Each of the Sections Had Undergone 19,000 Revolutions at Chicago

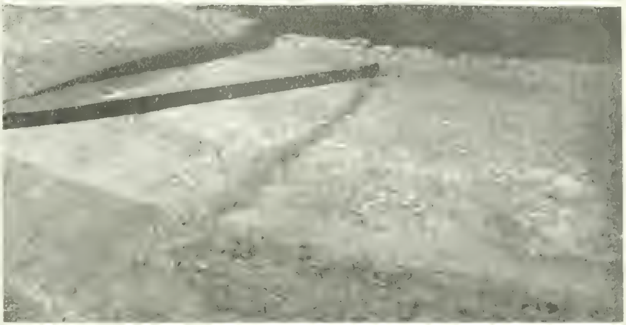

Fig. 8—(Center) This Shows Section No. 1 After the Completion of the Test at Detroit or After a Total of Approximately 39,000 Revolutions

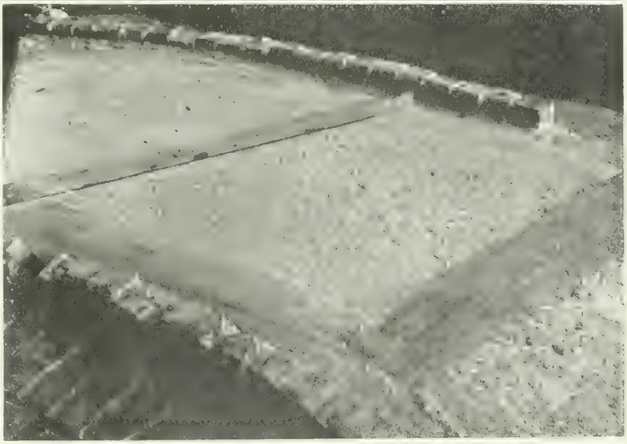

Fig. 9—(Bottom) This Shows Section No. 2 After the Finish of the Test at Detroit

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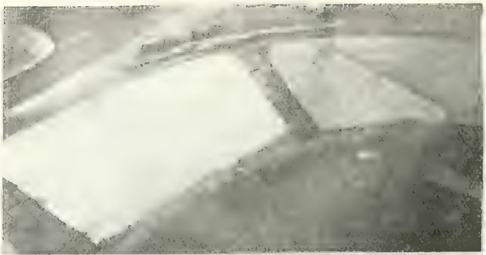
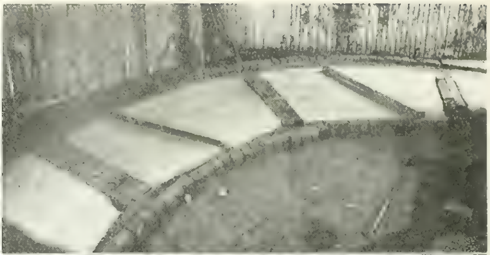
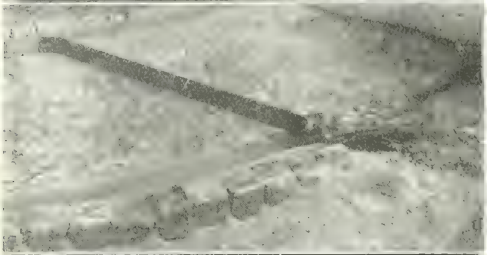
[1] Chicago

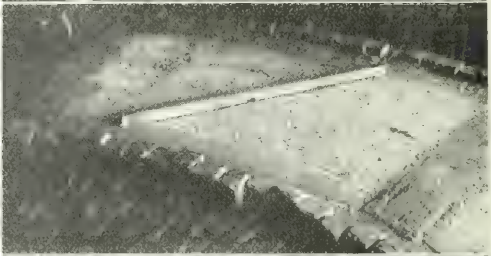
[2] R. D. Baker Co., Detroit

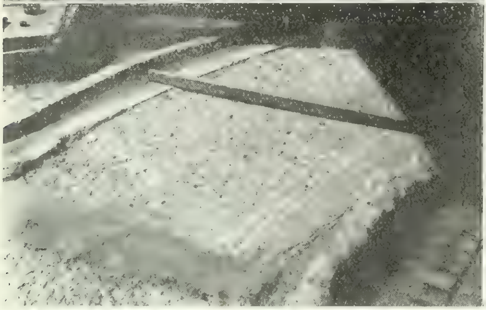
[3] As the main purpose of these tests was to determine the best concrete mixture for wear, and as the matter is here published in that spirit we refrain from detailed reference to macadam, brick and other sections tested under the determinator at Chicago. The article in the Dec., 1912, issue seems fairly to cover that phase of the matter.—Editors











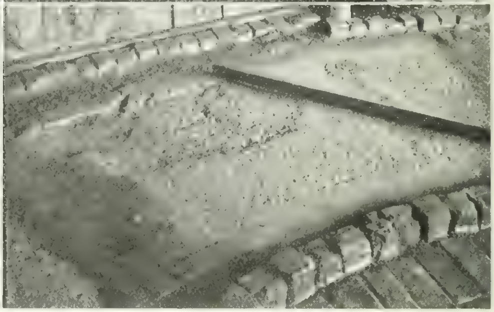


Fig. 10—(Top left) This Shows Sections Nos. 3 and 6 Before the Start of the Detroit Test. Section No. 3 Had Not Been Used Before and Section No. 6 Had Undergone About 16,000 Revolutions

Fig. 11—(Center left) This Shows Section No. 3 After 20,400 Revolutions

Fig. 12—(Bottom left) This Shows Section No. 6 After Approximately 36,000 Revolutions

Fig. 13—(Top right) This Shows Sections Nos. 8 and 9 at the Start of the Detroit Test. Each of the Sections Had Been Used Throughout the Test of 19,000 Revolutions at Chicago

Fig. 14—(Right center) This Shows Section No. 9 at the Completion of the Detroit Test

Fig. 15—(Bottom right) This Shows Section No. 8 at the Completion of the Test

creosoted wood block. Although the macadam section would not stand the test, the stone became so compact in the 10 hour's run, that it was removed with much difficulty with picks. From Saturday, Jan. 18, the machine ran approximately 10½ hrs. a day, being shut down about once an hour for a few minutes to inspect and to oil.

The work in Detroit in continuing the test was in charge of a representative of the Inspection Bureau, Universal Portland Cement Co., and he supplied the data for this report. The original 8-in. concrete floor put down in the eastern yards of the Detroit Department of Public Works to receive the determinator, was used for a foundation. On this was placed a 2½-in. bed of cement sand mortar, in a mixture of 1:1½ to bring the test sections up to the proper level. Over this was run ¼" of cement grout in which the slabs to be tested were bedded. The concrete pavement sections put down in Detroit on this mortar and grout foundation were arranged as shown in the accompanying diagram

Between sections there was a joint 8" wide made of 4-in. creosoted wood block put in with hot pitch and gravel. Soft steel plates were used at the edges of the concrete slabs. At the outset the determinator was run at 8½ r. p. m. which gave a speed of 6.6 mi. per hr. at the outer edge of the track, with a speed of 5.2 mi. per hr. at the inner circumference, or an average speed of 5.9 mi. per hr. This speed was maintained for 5,700 revolutions of each of the wheels of the determinator, and the pounding was so great as not fairly to represent vehicle traffic on a pavement. Before proceeding with the test in Detroit, three of the five plungers on each wheel were removed, leaving two to a wheel, which seemed to be fairly comparable to ordinary vehicle traffic with two horses, and eight hoofs to four wheels. After the 5,700 revolutions had been made, the speed was reduced to 6½ r. p. m. or 5 mi. per hr. at the outer circumference, 4 mi. per hr. on the inside, or an average of 4.5 mi. This speed was maintained until a total of 20,400 revolutions had been made, so that those slabs which had been previously tested in Chicago underwent a total wear of nearly 40,000 revolutions.

In this connection, it may be remembered that in the first test with the paving determinator at Detroit, a test under the direction of the Department of Public Works, some of the brick pavement sections had practically gone to pieces when 6,000 revolutions had been made.

Before the machine was started in Detroit very careful level readings were taken on each one of the slabs in the track, using an architect's level, reading to thousandths of a foot. Fifteen readings on each slab were taken within the wheel track, and one at each of the four corners of each slab outside the wheel track. There were other readings after 12,400 revolutions had been made and final readings at the completion of the test, after 20,400 revolutions. Final readings showed wear on the various slabs as follows:

Slab No.	Average wear after 20,400 rev. (given in in.).
1	0.19
2	0.11
3	1.38
5	1.77
6	0.24
7	0.26
8	0.18
9	0.13
10	0.44
11	0.16

In a resume of the observations made after the test the Inspection Bureau outlines the following:

Sections Nos. 3, 10 and 11 had had no wear previous to the test in Detroit. Section No. 5 was somewhat rough from previous wear when it was put down in Detroit. Sections Nos. 3 and 5 showed the concrete to be unsatisfactory for wearing surfaces. Section No. 3 was a mixture of 1 part cement, 2½ parts sand, and 5 parts gravel, screened, washed and graded from ¼" to 1½". Section No. 5 was a mixture of 1 part cement, 2 parts sand, 4 parts ¼" to 1½" screened, washed gravel. Both of these sections were worn down to the reinforcing metal and Section No. 5 was worn so badly after 12,000 revolutions in Detroit or a total of 31,000 revolutions that it was necessary to use gravel to help the wheels of the determinator over this slab. Section No. 2, which is one of those also used in Chicago, was still in perfect condition at the end of the test. This section is made of 1 part cement, 1½ parts sand, and 3 parts of a mixture composed of 4 parts 1-in. to 1½-in. and 3 parts ¼-in. to 1-in. crushed Wisconsin granite. This is the identical mixture, although not the same aggregate, used by the County Road Commissioners in the roads of Wayne County. Section No. 8, a slab which was made in two courses having a wearing surface 2" thick, of 1 part cement and 2 parts of a mixture composed of 1 part ¼-in. granite screenings and 2 parts ¼-in. to ¾-in. crushed granite, was not so satisfactory as section No. 2. The larger aggregate used in the one-course pavement therefore seemed to be better for heavy traffic. Section No. 9 made of a mixture of 1 part cement, 1½ parts sand and 3 parts 1½-in. crushed limestone, wore very smoothly, the wear of the stone being uniform with that of the mortar which bound it. The next leaner mixture of the same materials, however, did not prove to be satisfactory. This is shown by section No. 10, made of a mixture of 1:2:4 cement, sand and crushed limestone, in which the stone wore roughly and unevenly and indicated that a continuation of the test would render it unsatisfactory. Section No. 1 and section No. 6 wore uniformly, but with a slightly rough surface which, however, seems to be rather advantageous than otherwise, because it gives a good foothold. Section No. 1 is practically identical with the mixture now used in Wayne county. It consists of 1 part cement, 1½ parts sand and 3 parts ¼-in. to 1½-in. screened washed gravel. One edge of this section No. 1 was protected with Baker[2] metal plate. Section No. 6, similar to section No. 1, though rather more lean, was made of 1 part cement, 2 parts sand and 3 parts screened washed gravel, of the same size as in section No. 1. Section No. 7, having a wearing surface 2" thick of 1:2 mortar in which clean, coarse sand is used, with a base consisting of a 1:3:5 mixture of gravel concrete, wore very uniformly. Section No. 11 consists of a mixture of 1 part cement, 2 parts sand and 4 parts crushed granite, answering the same description as that used in No. 2, proved to be satisfactory by showing even wear, with a rough surface for good foothold. The objection to this mixture lies in the difficulty of obtaining a smooth surface without depressions, which is a most important requirement. The 1:2:4 mixture worked so badly, that although the slabs were made under laboratory conditions, it was impossible to finish section No. 11 smoothly and the hammering caused by unevenness resulted in a depression at one corner.

The tests have demonstrated that a satisfactory wearing surface, under the most severe traffic conditions, can be obtained with a 1:1½:3 mixture, of cement, clean, coarse sand and coarse aggregate consisting of well graded, screened, washed gravel, or graded, crushed limestone, ranging in size from ¼ to 1½ inch. The gravel and limestone referred to are materials sold in the Chicago market.

Fig. 10. Arrangement of Slabs in Track in Detroit Test.

A 1:2:4 mixture with either of these materials, or mixtures containing less cement, will not withstand the impact and abrasion of traffic in a degree at all comparable to the richer mixture.

A 1:2 mortar, made with clean, coarse, well graded sand, will withstand the effect of heavy traffic satisfactorily, although the wear is greater than on surfaces containing coarser material.

Gravel containing a small percentage of soft stones is objectionable because the soft stones give points for the wear to start. For this reason crushed stone, containing material of uniform hardness, shows equal value to gravel, consisting of harder particles, but with a small proportion of soft pebbles.

Crushed Wisconsin granite, graded in sizes from ¼ in. to 1½ in., was, unquestionably, the best material used for coarse aggregate in the slabs tested.

Unevenness of surface finish, due to the poor workmanship causes pounding under heavy traffic and develops holes in the pavement, which, if smooth, would withstand the same traffic perfectly for an indefinable period.

Annual Meeting of the American Society for Testing Materials

The American Society for Testing Materials will hold its 16th annual meeting at Atlantic City, N. J., June 24-28, 1913, with headquarters at the Hotel Traymore.

An interesting program of addresses has been prepared by the committee in charge. Of special interest to the readers of Concrete-Cement Age will be the sessions of Wednesday morning, June 25, when Sub-Committee V of Committee A-1, W. K. Hatt, Chairman, will report on tests made on rail-steel concrete reinforcement bars; Wednesday evening, June 25, on steel and wrought iron; and Thursday's sessions, June 26, on Cement and Concrete in the morning, and on Cement, Concrete and Waterproofing in the afternoon. The following program has been arranged for Thursday, June 26:—

10 A. M. Report of Committee C-1: On [illegible] Cement. George F. Swain, Chairman.

Report of Committee C-2: On Reinforced Concrete. F. E. Turneaure, Chairman.

A Method and Apparatus for Determining Consistency. C. M. Chapman.

[illegible] Fine Particles in Cement by Rate of Hydration. Henry S. Spackman.

The Physical Action of Various Substances on Cement Mortars. Richard K. Meade.

The Results Obtained with the Autoclave Tests for Cement. H. J. Force.

Screen Scale Sieves Made to a Fixed Ratio. G. A. Disbro.

3 P. M. Report of Committee D-8: On Waterproofing Materials. W. A. Aiken, Chairman.

Coal-Tar and Asphalt Products for Waterproofing. Samuel Tobias Wagner.

Test of Natural Concrete Aggregates. Russell S. Greenman.

Test of Mortars Made from Wisconsin Aggregates. M. O. Withey.

Some Tests of Reinforced Concrete Slabs Under Concentrated Loading. A. T. Goldbeck.

Test Data on an Experimental Concrete Bridge. A. N. Johnson.

The Thermal Activities of Portland Cement. Louis N. Beale, Jr.

Friday, June 27, there will be an interesting session on ceramics and road materials.

Ceresit Waterproofs Cement Mortar and Concrete. Ceresit Waterproofing Co., 129 S. Clark St., Chicago. 9" x 6½", paper bound, 12 pp., illust. This catalogue describes some of the essential features of waterproofing problems, presents a brief description of what "Ceresit" is, and tells how to use it. Probably the most interesting feature of the catalogue, however, is some very interesting illustrations of work in which "Ceresit" has been used.

Artistic Molds. Architectural Mold Co., 1117 E. Warren Ave., Detroit. 10" x 7¾", paper bound, 16 pp., illust. This catalogue describes in detail the mold made for various architectural features such as balls, spindles, columns and column capitals. An interesting feature of the catalogue is the description of molds for garden furniture, such as lawn vases, pedestals and flower boxes.

Catalogs and Other Trade Publications.

The Cement Gun. General Cement Products Co., 30 Church St., N. Y. C., 9" x 6", paper bound, 20 pp., illust. This catalogue, while stating briefly what the cement gun is, is given over mainly to descriptions of various work on which this equipment has been used.

Gas and Gasoline Engines. Du Bois Iron Works, Du Bois, Pa., 9¼" x 6¼", paper bound, 24 pp., illust. This catalogue describes in detail the essential features of these engines. Entire pages are given over to each important feature of the machine with the result that the catalogue presents a very complete exposition of Du Bois engines.

High-grade Engineering Instruments. The Hanna Mfg. Co., Troy, N. Y., 7½" x 5¼", paper bound, 72 pp., illust. More and more, constructors are recognizing not only the need of accuracy in building work, but that engineering instruments are the most efficient means of securing this accuracy. Consequently, at the present time there is a transit or a level, or a combination transit and level, on almost every construction job of any size. This catalogue describes a complete line of instruments, tapes, etc.

Stucco Suggestions. The Standard Paint Co., 100 William St., N. Y. C. 6¼" x 3½", paper bound, 8 pp., illust. This little circular describes the use of "Impervite" in making stucco waterproof. It emphasizes the use of a leaner mortar for stucco than is called for ordinarily, and with this leaner mixture stucco can be waterproofed. Impervite is a waterproofing material made by the Standard Paint Co.

Cemcoat. L. Sonneborn Sons, Inc., N. Y. C., 11" x 8", paper bound, 4-page folder. "Cemcoat" is a liquid coating prepared from various ingredients and is applied to masonry or plaster surfaces to make them waterproof. The manufacturers state that "Cemcoat" has no chemical reaction with cement or any of the ingredients of concrete, and can be used on brick, slate, wood, metal or canvas. It is elastic and develops great adhesion to the surface to which it is applied.

Original Air Cooled Engine. The Original Gas Engine Co., 650 Kalamazoo St., Lansing, Mich., 6¼" x 3½", paper bound, 8 pp., illust. This little catalogue describes the essential features of "Original" air cooled gasoline engines. This machine, designed by R. E. Olds, is a light engine intended especially for small contracting and farm work.

Concrete Machinery. The Iowa Foundry Co., Sioux City, Ia., 11" x 9", paper bound, 10-page folder, illust. This folder, prepared uniformly with architects' specifications, describes block machines, block tampers and mixers. This company also makes a wire-cutter which cuts the steel ties used in making the two-piece block.

Industrial Railway Equipment. The Electric Locomotive & Car Co., West Park, O., 9" x 6", paper bound, 100 pp., illust. This catalogue, which is bound with post binders so that later bulletins can be edited any time and the catalogue kept up to date, illustrates a complete line of industrial rolling stock equipment. Most of the equipment manufactured by this company is especially adapted for brick plants, and blast furnaces; many of the small cars shown would have a direct application in the concrete field.

Barr "Unit-Compound" Air Compressor. Pennsylvania Pneumatic Co., Erie, Pa., 6" x 3½", 8-p. folder, illust. This is a folder describing a compressor engine, the salient feature of which is that the compressor and the power engine are contained in one body. The cylinders are at right angles to one another. This produces compact and efficient mechanism.

Lapidolit. L. Sonneborn Sons, Inc., N. Y. C., 6¼" x 3½", paper bound, 12-page folder. This is a colorless liquid compound applied to concrete to make it impervious to moisture. "Lapidolit" can be used as a priming coat for paint, and is especially useful in floor work.

Face Plates. The Pettyjohn Co., 629 N. Sixth St., Terre Haute, Ind., 8½" x 5½", paper bound, 8 pp., illust. This is a detailed description of the operation of the Pettyjohn block machine, emphasizing especially the use of face plates.

Gorton Self-Feeding Boilers. Gorton & Lidgerwood Co., 96 Liberty St., N. Y. C., 7" x 4", paper bound, 24 pp., illust. In this booklet are presented briefly the essential features of the system of hot-water heating developed by this company. Many types of hot-water boilers are illustrated.

First Aid Manual. Johnson & Johnson, New Brunswick, N. J., 8½" x 6", cloth bound, 144 pp., illust.

This is the fifth edition of a manual which has had extended use. "A stitch in time saves nine." An elementary understanding of first-aid essentials comes in very handily on construction work, where minor accidents often occur. This book is essentially a working manual in first-aid work. The suggestions are not intended to be elaborate. Every problem is fully illustrated by detailed photographs, and the book should be universally useful.

Shovels. The Conneaut Shovel Co., Conneaut, O. 6" x 3", paper bound, folder, illust. This is a convenient pocket folder which lists and prices a complete line of shovels.

The Abrasive Age. The Carborundum Co., Niagara Falls, N. Y. 12" x 9", paper bound, 16 pp., illust. This is the first number of a bulletin published by this company, and shows in detail many of the interesting uses of carborundum. This issue is devoted particularly to the use of abrasives in furniture manufacture.

Thomas Hoists. Thomas Elevator Co., 20-22 Hoyne St., Chicago. 10½" x 7½", paper bound, 64 pp., illust. In handling concrete on building work one of the essentials of the contractor's plant is hoisting equipment. This catalogue describes and illustrates a complete line of electric, steam, horse, and hand hoists for builders. The installations of hand hoists are very ingenious indeed. The catalogue is well illustrated.

Chimneys. The Weber Chimney Co., Chicago. 9" x 5", paper bound, 48 pp., illust. This booklet describes Weber concrete chimneys, methods of their construction and shows many interesting photographs of recent work. The booklet is a striking illustration of the wonderful place concrete is taking in modern industrial development.

Contractors' Equipment. Waterloo Cement Machinery Corp., 105 Vinton St., Waterloo, Ia., 9" x 6", paper bound, 24 pp., illust. This catalogue describes the well known "Polygon" mixer manufactured by this company. The "Little Wonder" open-drum concrete mixer, a horse drawn concrete spreader cart for pavement work, block machine, stone crushers, gasoline engines, culvert molds, stone and sand screens and wheelbarrows are also manufactured by this company and described in this catalogue. A large line of contractors' equipment is shown.

Water Powers. Stone & Webster Engineering Corp., Boston, 8" x 6", cloth bound, 66 pp., illust. This is an artistically prepared and interesting compilation presenting brief data regarding the various water power plants which have been constructed by the above company, Concrete is the material used practically exclusively, and so the booklet becomes an interesting compilation of concrete dam and power house construction.

Ornamental Illumination. The Pettyjohn Co., 629 North Sixth St., Terre Haute, Ind., 11" x 8", paper bound, 12 pp., illust. This is an interesting catalogue describing in detail the use of concrete standards for street lighting. The catalogue brings out emphatically the efficiency of concrete for this use, and states that the cost of a concrete standard is about 1/10 of that of natural granite and about ½ that of cast iron. They do not require painting or repairs and in every way make for efficiency and economy. A modern concrete light standard is a great improvement over the iron lamp posts of our younger days.

Witte Engines. Witte Iron Works Co., Kansas City, Mo., 12" x 9", paper bound, 32 pp., illust. This catalogue describes in detail the plant where these gasoline engines are made. It describes in detail each individual type of machine put out by this company, and presents a description of each one of the particular parts of the machine itself. It will be found a valuable catalogue to any contractor contemplating the purchase of a gasoline engine.

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